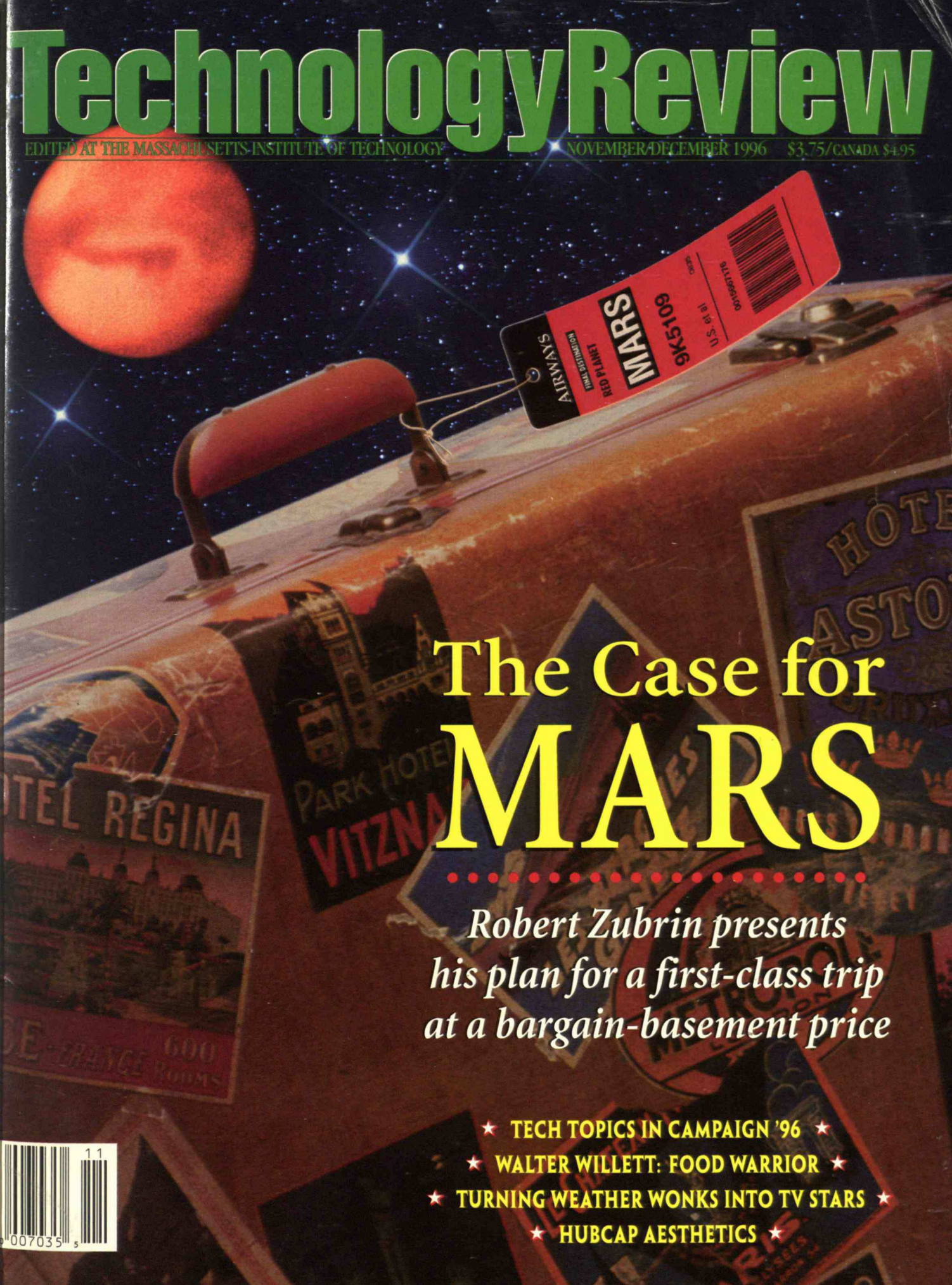
Technology Review
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★ WALTER WILLETT: FOOD WARRIOR ★
★ TURNING WEATHER WONKS INTO TV STARS ★
★ HUBCAP AESTHETICS ★

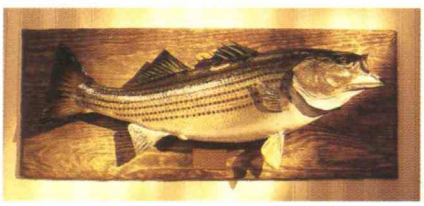
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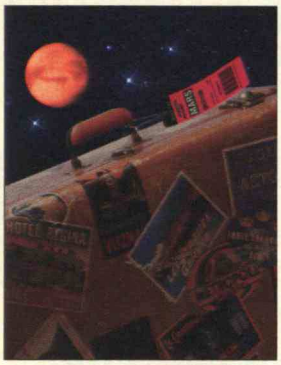
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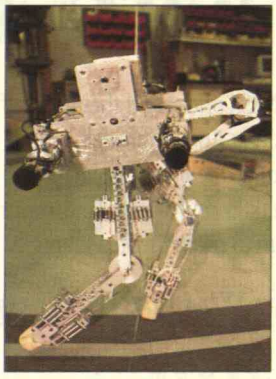

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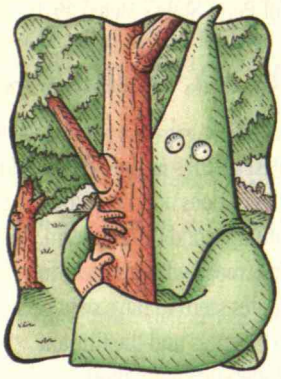
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First Line

Ask the Librarian

The experts who can help us find research-quality information on the Internet, and teach us to fish for ourselves, are readily available.

THE World Wide Web is one terrific diversion. I've spent many a delightful hour with it, checking out some of the offerings of the mighty troupe of players who strut and fret upon this truly worldwide stage.

And I've been pleased by my modest but growing skill in using the Web to find practical bits of information: movie times, restaurant reviews, airline schedules, the weather in places nearby and far away. But I agree with critics who say that although the Web could become the ultimate library—a vast network of links to the repositories of the world's knowledge—it is not yet a convenient tool for serious researchers, or for most other professionals, such as journalists, seeking solid documentation in their work.

It's not as if research-quality bytes aren't out there—somewhere—it's just that the particulars one seeks through the Web are often devilishly hard to find. Though *PC/Computing* columnist John C. Dvorak asserts that "95 percent of the pages served up on the Web are useless garbage," I'd point out that 5 percent of some 50 to 100 million pages (the current range of guesstimates by leading webmeisters) sounds like a lot of good stuff, and there's no reason why that percentage shouldn't climb as more heavy-duty players get into the act.

And it's not as if we need to muck around in all that "garbage." A huge advantage of the electronic medium is its precision and potential selectivity: our computers should enable us to pull from the Internet only what we need, leaving us unfettered by all the rest.

That selectivity, however, remains potential. When we click now on a link there's no way to predict the relevance, depth, or quality of what will appear on the screen. The reason is that Web documents, unlike those of a true library, are largely uncatalogued and unorganized. Unable to logically and systematically track down what we need, most of us endure numerous false leads and dead ends until we get there—*if* we get there. We partake of the intellectual riches of cyberspace mainly by chance.

That chance is manifested in the Web's "search engines"—easily accessed services such as InfoSeek, Yahoo, and Alta Vista—that depend mostly on keywords. Type into the search box a few of the terms that will likely appear in the documents you're looking for and then click on the search icon; the engine will scour the Web, sort through mass quantities of diverse information, and promptly deliver an essentially undifferentiated list of sites—often, thousands of them.

Most of the search engines do provide a dozen or so broad subject categories, apart from the main search function, that seem to promise a deliberate, focused, and logical sequence from the general to the particular. But in fact the categories usually lead to just a few bonbons—a small, arbitrary, and not particularly tasty sample—from the great big candy store. As the chairman of one search-engine firm explained to me, such categories are not meant to satisfy the needs of "searchers" but are offered merely for the amusement of "browsers." For the latter, he said, we "improve the quality by limiting" rather than deepening the nominally organized offerings.

A great deal of innovation is obviously required if the Web is to transcend its entertainment value and also serve a serious research function with resources organized in the best scholarly traditions. It needs the contributions of a wide range of professionals, especially those in the field of "information sciences" itself, to help build, as computer-industry guru Mitchell Kapor has put it, an "overarching classification scheme to avoid knowledge chaos."

While we await such schemes, a good strategy is simply to ask a knowledgeable person. And what could be better, writes columnist John Yemma in the *Boston Globe Magazine*, than to "do what your third-grade teacher taught you: ask the librarian." These "astronauts of cyberspace," he says, "aren't just working in book-lined warrens these days." They've gone high-tech, and can provide the online researcher with reference assistance just as capably as they've traditionally done with print. (I must admit to some bias here: my wife is one of them.)

But these experts are a scarce resource; we should reserve them for the truly difficult searches and learn to do the prosaic ones ourselves. My own third-grade teacher used to say that there's an art to just about everything, and that it can usually be taught. Therefore, in the spirit of "give a man a fish, and he'll eat for a day; teach him how to fish and he'll eat for a lifetime," why not teach students just enough of the librarian's art so that they'll develop some Internet self-reliance—and, in our information-rich world, a minimum degree of functional literacy?

My wife used to teach just such a course, in pre-Internet days, to college freshmen. Called "Information Searching and Media Communication," it was one of four (the others being English, history, and speech) in an integrated program funded by the National Endowment for the Humanities and the Council on Library Resources. She worked with teachers of the other three, more traditional, subjects to help students make effective use of the library's wares for researching and presenting their assignments. I envied those kids, who were gaining the ability to "eat for a lifetime" from waters that forever intimidate most other people.

Sadly, that program was terminated, and to our knowledge has not been revived. Yet in the midst of an "information revolution" it ought to be a major national trend. At present, we relegate the acquisition of online know-how largely to *self*-teaching, but that works for only the gifted. As is generally true for acquiring literacy and skill, the rest of us need some formal help in learning early, learning well, and keeping up to date. ■

—STEVEN J. MARCUS

TechnologyReview

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Letters

ALIVE AND WELL

In "The Twilight of Science" (*TR July 1996*), John Horgan ignores the reality that our species inhabits an environment where physical laws are constant but change is the norm. As long as humans interact with their changing environment, they will ask questions that are probably best answered by science.



Several years will most likely pass before we have a satisfactory understanding of matters such as the nature of consciousness, the control of cancer, and the existence and nature of extraterrestrial life. Will we run out of the questions that fuel scientific inquiry? Only if humanity loses its taste for useful answers.

By making a distinction between applied science and science at its "purest and grandest," and observing that the latter is in its twilight, Horgan discourages people from learning about scientific reasoning and thus pursuing the preceding questions.

Also, by "science at its grandest" Horgan seems to mean science that addresses our place in the universe, tells us who we are, where we come from, and where we are going. But such interpretation is more a matter of philosophy than science.

SIMON DELAGRAVE
Arlington, Mass.

How curious that in this time of scientific efflorescence, Horgan should follow the lead of two prophets of the end of science, Oswald Spengler and Gunter Stent, and look in the rearview mirror. Perhaps Horgan has transposed his end-of-the-millennium angst to science.

As Horgan knows, major unknowns remain. Physics is confronted with the origin of particle masses and the reconciliation of gravity and quantum theory. Cosmology is still attempting to understand the dark matter that may comprise 90 percent of all mass and stars of age seemingly greater than our universe. Biology merely hints at the strategy by which human beings develop and therefore the mechanisms by which evolution proceeds. Scientists have devised mere outlines of the brain's neuronal organization and functions. And we have hardly a glimmer of understanding about the basis of consciousness. In psychology, we are just beginning to perceive the genetic factors that underlie the nature-nurture interaction that produces the psyche.

And these are only some of the conundrums we can now envision. Science has far, far to go before ennui.

ROBERT L. SINSHEIMER
Professor of Biology, Emeritus
University of California
Santa Barbara, Calif.

In his interesting essay, Horgan seems to treat science and engineering as the same thing. In fact, they are quite different activities—to the extent that while science may be nearing its end, the age of engineering has scarcely begun.

By failing to distinguish the two, Horgan implies that human life will remain Earth-bound and rather dull. He seems to be thinking of government-funded science when he writes that "the prospects for space exploration on anything more than a trivial scale seem less and less likely." The need for living space, adventure, and business will prompt humans to use engineering prac-

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tices to spread throughout the solar system and then the galaxy.

Horgan is even too quick to draw down the curtain on science. Without justification, he writes, "Biologists are unlikely to make us immortal." Considering our progress toward total understanding of DNA, I offer three possibly revolutionary topics in biology: immortality/longevity, artificial life, and reengineering the human body.

PATRICK COLLINS
Visiting Research Fellow
University of Tokyo

FIGHTING THE EXOTICS

As someone who fights California's "Weeds from Hell" (*TR August/September 1996*), I found that David Tenenbaum did an excellent job of explaining the problem of invasive, exotic plant



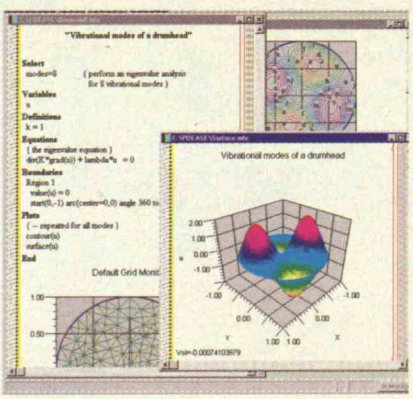
species. In our state alone, arundo (a.k.a. big cane) competes with salt cedar for possession of riparian habitats. Yellow star, bull and Italian thistle, and numerous species of Eurasian annual grasses carpet meadows and grasslands. German ivy creeps under and over our forests and coastal savannas (similar to the kudzu highlighted by Tenebaum, German ivy is a vine on steroids). Fennal and lepidium cover our seasonal wetlands, while pampas grass and ice plant have overrun coastlands. Woody shrubs occupy more than 1,000,000 acres of former forest and rangeland. These are only a sampling of the 90 species listed as exotic plants of greatest ecological concern in California.

Are we discouraged? Sometimes. But the 417 members of the California Exotic Pest Plant Council have found that a combination of education, coordination, and protracted volunteer efforts is effective in locally removing and controlling these species—even with a low level of funding. Education is imperative to marshalling funding, volunteers, and support for legislation. Coordinating removal and control efforts among government, conservation groups, and private landowners is necessary because exotic plant species left on the other side of the fence will soon reinfect treated lands. Coordination also maximizes the effects of monetary and human resources.

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Although federal, state, and local land managers in California are aware of the consequences of ignoring exotic species, most of our efforts are still implemented by volunteers. The Habitat Restoration Team in Golden Gate National Park, Friends of Los Penyosquitos Creek, and the San Francisquito Creek Conservationists of Palo Alto are just three examples of the 50+ local weed-warrior groups that have successfully removed exotic plants from threatened wildland habitats in California. It is only a start, but it *is* a start.

CARLA BOSSARD
President
California Exotic Pest Plant Council
Associate Professor
St. Mary's College of California
Moraga, Calif.

PROTECTING ONE'S SPACE

In "Downsizing Infrastructure" (*TR May/June 1996*), Clark Wieman lauds the New York City Department of Environmental Protection for proposing "a program to protect upstate watershed



areas." The author notes that the program was opposed by "an upstate business community emboldened by a new Republican governor." I live in one of the many towns that would have been affected by the program's ban on development without compensation to towns or property owners. The fundamental problem with the proposal was that it would have saved New York City up to $8 billion by effectively seizing property rights worth far more than that. This usurpation of rights provoked outrage among town residents and businesses alike, and from both Democratic and Republican town counsels.

BRIAN CARR
Jefferson Valley, N.Y.

In advocating fewer parking spaces for new construction sites, Wieman appears to have never traveled with young children or infirm elderly parents. The car is more to them than transportation: it's their toy room, changing table, nursery, pantry, rest stop, and medicine cabinet. If an urban destination lacks parking, we won't go. And that means we also won't visit its restaurants, cafes, and boutiques.

DIANE R. SEMMLING
Piscataway, N.J.

Wieman suggests curtailing auto travel to reduce the need for additional highway lanes. What about trucks? Every time I follow one on the highway I wonder if its load could more effectively be transported by rail.

The federal government has long been downsizing railroads while increasing highway construction. Although poor railroad management was a factor, regulatory policy and taxation also hurt the railroads. A study of the differences in shipping costs between the two might prove that railroads are a more fertile area for reducing infrastructure.

WILLIAM O. ZIMMERMAN, JR.
New Kensington, Pa.

REALITY CHECK

In responding to "The Electric Car Unplugged" (*Letters, TR April 1996*), Trudy Coxe, Massachusetts secretary of environmental affairs, refers to the "significantly greater inefficiency of automatic-transmission, gasoline-powered vehicles," their "enormous waste-heat loss," and their "grossly inefficient fluid torque converter, which weighs 500 pounds and adds more than $1,000." By walking to the nearest car repair shop, Coxe could have learned that a converter for a car comparable in size to existing EVs can easily be picked up with one hand and does not cost $1,000 (Coxe probably added parts and labor). The garage mechanic could also have told her that the converter is 100 percent efficient as soon as the transmission shifts to a high gear.

STANISLAV JAKUBA
West Hartford, Conn.

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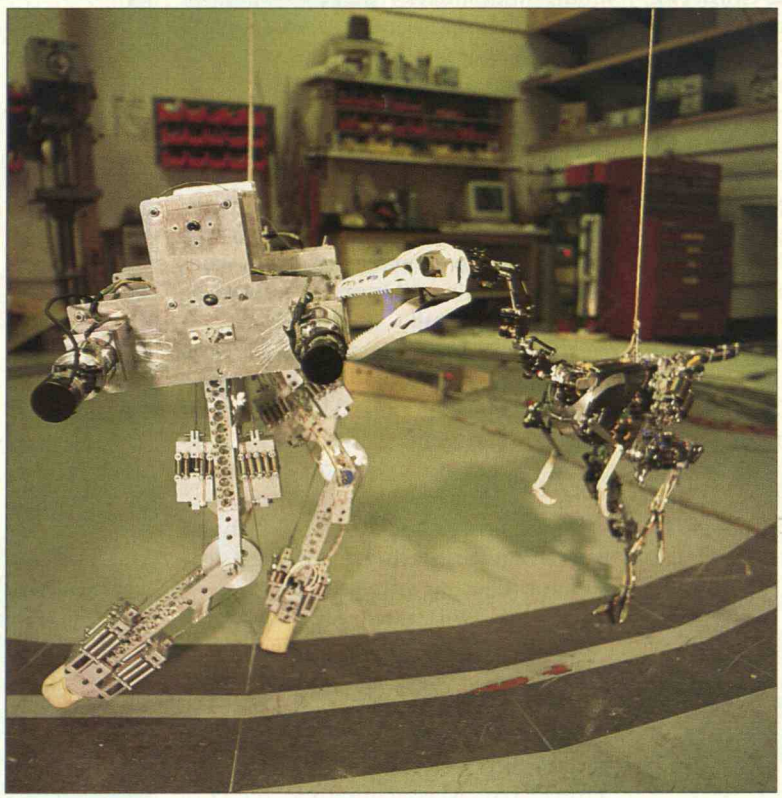
Robots on All Twos

Most engineers building walking robots for hazardous duty such as exploring volcanos and cleaning up chemical spills have traditionally designed machines with four or more legs. The logic has been that these devices are less likely to topple than two-legged machines.

But Gill A. Pratt, an assistant professor of electrical engineering and computer science at MIT and director of the Leg Laboratory, a branch of the Artificial Intelligence Laboratory, is designing two-legged walking robots. The costs associated with robots produced in quantity, he explains, largely involve physical parts, such as the motors, gears, joints, and sensors associated with each leg. Fewer legs mean fewer parts and lower costs, he maintains.

The concern about balance, Pratt says, can be resolved with a different approach to directing robotic walking—a method whose relative simplicity might also prove of interest to engineers who continue to design walking machines other than bipeds. He explains that designers of walking robots have typically installed computer programs that regularly check the placement of the limbs relative to their surroundings, then direct how body parts should move in response to environmental conditions. When, for instance, a robot must take a step, the machine calculates how far the foot is from the ground and then extends the foot that distance. This method has low tolerance: if the measurement is a bit wrong, so that the foot is initially farther from or closer to the ground, the robot could either stumble or push too hard and cause damage. The technique therefore requires users to develop elaborate code to instruct the legs exactly where to move under a wide variety of conditions, Pratt says.

But building on research by Neville Hogan, professor of mechanical engineering and brain and cognitive sciences at MIT, Pratt devised a program that continually checks just four factors that involve only the robot: the degree of body pitch, the machine's forward speed, and the placement of legs and hips relative to other parts of the body. The program then tells the motors associated with body parts such as legs how much force they should use to move a limb. Rather than telling a body part how far it should move, the software relies on feedback and incremental force instructions to ensure that the stepping leg will always eventually reach the ground, leaving the robot balanced and causing no damage. The technique also makes for simpler programming by robots' end-users, Pratt says, since they don't have to try to predict every possible kind of step.



Walking robots have traditionally balanced on four or more legs. But by incorporating a novel approach to movement into the software that controls the machines, MIT researchers are developing Spring Heron (left) and the dinosaur-like Troody to rely on only two legs.

The motors used to control force do typically require costly gears, because standard gears tend to reduce force unpredictably. But the Pratt team avoided this problem by attaching simple, cheap springs between the robot joints and the cables that connect to inexpensive gears. The springs' stretchiness cushions the differences in force, he explains. And the robots still cost less than walking machines with more legs.

Pratt put his innovations to the test late last year in his first walking prototype, a two-foot-tall machine named Spring Turkey. Attached to a boxy torso, the robot's two legs bend at their top ("hip") and midsection ("knee"). Pratt's team tethered Spring Turkey to an outside energy source and a boom that simplified the trial of the first-generation machine by eliminating the need to balance sideways. Spring Turkey then successfully strutted its stuff.

Building on that effort, Pratt and Jerry Pratt (no relation), a graduate student in electrical engineering and computer science, have since been developing a second biped, Spring Heron, with jointed, motorized ankles. "We're interested in seeing how a foot and jointed ankle can benefit bipedal walking," says Gill Pratt, who expects that the machine's balance will improve further as a result. In part,

PHOTO: L. BARRY HETHERINGTON

the ankle should enable weight to switch and be distributed appropriately between the "heel" and "toe" area of the foot, so the robot can mimic the technique humans use to balance on one leg. And by exerting more pressure on the toe area, jointed ankles should help push the legs forward so the machine can walk at faster speeds and negotiate shallow inclines.

Most recently, Pratt has also been working with Peter Dilworth, a Leg Lab technical assistant, to build a third robot. This machine, called Troody after a bipedal dinosaur known as Troodon, will incorporate onboard battery power as well as a long tail and birdlike feet consisting of two prongs to aid balance even more. Troody will also rely on gyroscopes to sense its side, vertical, and horizontal positions and its velocity, eliminating the need for a boom; two extra motors at each hip will translate that information into sideways movements. Although such additions clearly raise the price of this instrument, its parts still cost less than those of comparable "high-performance" robots with more legs, according to Pratt. Troody, which the engineers anticipate will be up and walking next spring, should be the first fully autonomous walking biped to emerge from the Leg Lab.

As they advance, Pratt and his team recognize applications for their work other than cutting robot costs. Two-legged walking robots could be used to carry heavy supplies in a workplace or in a battlefield situation where narrow stairs or pathways must be negotiated, says Robert Ringrose, a Leg Lab technical assistant. And studies of how bipedal, force-controlled robots walk might be useful in analyzing human leg movements, he adds. Better understanding of the forces bipeds employ for walking might lead to advances in, for instance, physical-therapy techniques.

—*BARBARA MORAN AND LAURA VAN DAM*

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NORTH BY WHATEVER

It is a typical day at the MIT Sailing Pavilion on the Cambridge side of the Charles River. A throng of schoolkids mills about, waiting their turn for a morning sail. The odd motor launch whizzes up to the dock. And Tom Vaneck has his toy boat out again.

Well, it's not exactly a toy. The boat is a three-foot-long scale model of a fishing trawler, and Vaneck, a control engineer in MIT's Sea Grant College program, sure is having fun with it. But even a casual glance reveals there is more to the boat than plastic and glue. A satellite antenna juts like a mushroom from the deck, and beneath a clear Plexiglas cover on the forward hull, tightly packed electronic instruments bristle and blink like a bomb out of some TV thriller. Leaning over the boat—which he designed with the aid of two students, Claudia Rodriguez-Ortiz and Mads Schmidt—Vaneck rattles off his vessel's contents: digital compass, radio modem, Global Positioning System (GPS) receiver, depth transducer, computer with 1-gigabyte hard drive, two 12-volt batteries.

And a fuzzy controller.

The hardware is off-the-shelf, but the software—the fuzzy controller—is Vaneck's creation. It is what keeps him coming out to the Charles day after day, rain or shine, and it is what keeps his boat on course. A kind of sophisticated autopilot, Vaneck's controller represents a radical new system for autonomous navigation. Like the speedboats motoring downriver that day, it appears bound to make waves—in this case, throughout the field of oceanography, from navigation to pollution monitoring.

Fuzzy logic plays a role in many new products—keeping pictures steady in camcorders, for example, and controlling dryness settings in state-of-the-art clothes dryers. But no one had tried to develop a navigation system based on the oxymoronic process until Vaneck read *Fuzzy Thinking* (1993), by the philosopher-scientist Bart Kosko, and decided to give it a try. First described in the 1960s by Lotfi Zadeh, a mathemati-

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cian at the University of California at Berkeley, fuzzy logic has shaken the foundations of formal reasoning. It operates on the assumption that the world is not black or white, true or false, zero or one as logicians have held ever since Aristotle said "everything must either be or not be." Fuzzy logic says the world is gray, full of partial truths and partial falsehoods, somewhere between zero and one. As Vaneck puts it, "Fuzzy logic is a way of formalizing uncertainty."

Connecting the Dots

With his craft bobbing gently at dockside, Vaneck demonstrates his new system. On a laptop computer, he programs a sample mission by setting the coordinates of a number of waypoints—invisible three-meter-wide circles—that the vessel will have to cross in the Charles. He also prescribes a heading angle for the crossing to ensure that the vessel is properly positioned to move on to the next waypoint. Vaneck then downloads the mission over a cable into the boat's computer and waits for its GPS antenna to pick up at least three satellites for positioning. (Vaneck's boat can know its location on the river to within about a meter.) Once the boat locks onto the satellites, Vaneck disconnects the umbilical and launches the boat into the Charles. From this moment on, things get fuzzy.

"Fuzzy logic mimics the way a human thinks," Vaneck says. "For instance, when driving a boat, if you're a little bit to left of course, you turn a little bit to the right. If you're way left of course, you turn hard to the right. The fuzzy controller does the same thing." During a typical connect-the-dots mission such as today's, Vaneck's controller strives to keep the boat headed along a fictitious line through each waypoint. To keep on that line, which represents the proper heading, the controller continuously reassesses its position—is it off course by a little, a medium amount, or a lot?—and rapidly makes the corresponding rudder adjustments. To guide the boat properly, the fuzzy controller does not have to know precisely where it is headed at all times but only roughly.



Claudia Rodriguez-Ortiz, a graduate student in MIT's Department of Ocean Engineering, displays the boat she helped design, a craft that navigates autonomously using fuzzy logic.

The most widely used controllers for automatic systems rely on decidedly unfuzzy mathematical models. Known as proportional-integral-derivative controllers, or PIDs, their ilk have underlain mechanisms from automobile cruise controls to train auto-braking systems ever since James Watt developed the flywheel governor to regulate steam engines in the eighteenth century. Designed for so-called linear systems, in which any given output is directly proportional to any given input and in which the range of variables is limited and known, PIDs excel at the one task for which they were designed—keeping a car at a desired speed, for instance.

Navigating a boat on open water presents challenges that are difficult to meet with a PID controller, however. Uncertain variables like wind and waves make navigation a multivariable, nonlinear process that is not suited to PIDs, Vaneck says. For one thing, like the proverbial simpleton who can't walk and chew gum at the same time, PIDs are not able to perform two or more tasks simultaneously; for that, you must string together several individual PIDs. Vaneck, who has built more controllers than you can shake a stick at, wanted one that could both guide his boat to a waypoint and cross that waypoint on a certain heading. The two separate PID controllers required to handle those two functions would continually fight with each other, he says. With currents, waves, and wind ever nudging the vessel off course, the controller in charge of hitting the waypoint would regularly have to call for a heading, or rudder angle, that differed from the rudder angle required by the PID controller in charge of crossing the waypoint on a prescribed heading. What's more, if the boat missed a waypoint, Vaneck wanted it to be able to steer itself back around for another try, which would require yet another PID.

"I just wanted one controller," Vaneck says. "When I thought about how to do this with other controllers I know how to build, it became more and more of a nightmare. But with fuzzy control, it was a breeze."

Vaneck also needed a controller that would navigate properly no matter how he altered the vessel it was controlling. Every time he sends his boat out on a mission, Vaneck adds and removes sensors for different types of data collection. Such changes transform the vessel's drag, weight, and other characteristics. Since PIDs rely on a rigid set of mathematical equations, a change as simple as installing another battery to the boat would require a time-consuming reconfiguration. But the fuzzy controller considers everything not as absolutes but as matters of degree, and so is able to take such changes in stride.

The controller takes the so-called "crisp" inputs of position and heading

PHOTO: MADS SCHMIDT

and makes them fuzzy—that is, determines how far they are from the ideal position and heading, which is set at zero. "The fuzzy controller doesn't understand $x = 5$," Vaneck says, "but rather asks, 'How does x compare with what we want it to be, which is zero?' " More specifically, in the lingo of fuzzy logic, it asks whether the deviation in the heading is positive-small, positive-medium, or positive-big, or perhaps negative-small, negative-medium, or negative-big. In other words, is the boat right or left of course and to what degree?

The controller then sends these data to what Vaneck calls the "guts" of the controller, the "fuzzy associative memory" (FAM) bank. Found in all systems based on fuzzy logic, the FAM bank takes the fuzzified data and decides what to do about it. "Think of it as a series of 'if-then' statements," Vaneck says. "If my heading is negative-small, then I turn the rudder positive-small." Once the FAM bank has come up with the proper if-then statement, it sends a command to the rudder. "First it has to defuzzify it," Vaneck notes, "because the servo for the rudder will not understand 'give me positive-small'—it will understand 12 degrees." The whole process, from assessing position and heading to executing a rudder command, happens five times a second.

Fuzzy Outlook

Peering into the future, Vaneck imagines fuzzy controllers automatically guiding ships through channels, with human pilots monitoring the action. "You place waypoints in the channel and the boat navigates itself out," he says. "It takes human error out of it—the fuzzy controller never gets bored." Vaneck also imagines autonomous jobs. His model trawler is already collecting data for a map of the bottom of the Charles River, and Vaneck plans to gather similar data for a project to improve navigation in Boston Harbor. Another potential task is monitoring river outfalls for pollution. "The boat sniffs a pollutant, heads toward increasing concentrations, and drives right up and catches someone pumping the stuff into the water," Vaneck imagines.

Vaneck admits to feeling a certain amount of pressure to get a low-cost autonomous platform up and running. "Without technology like this, our waters are a less safe place to have ships," Vaneck notes. "We'd like to help change that." Nevertheless, he is not ready to go commercial just yet. First he wants to address what he calls the Achilles' heel of fuzzy control—the difficulty of knowing with a high degree of certainty just how the controller will react to all inputs it is likely to encounter. "For linear control systems," says Vaneck, "there are mathematical tests that can be performed to guarantee stability. For fuzzy controllers, there is no such test." Vaneck will have to subject his system to a wide range of wave heights, wind speeds, wind directions, and other variables before he can state with confidence that it behaves reasonably under all conditions.

Vaneck also wants to study ways of allowing multiple boats guided by fuzzy logic to work together. In oceanographic data collection, for example, many boats interacting with one another could sample a huge area simultaneously. Looking even farther over the horizon, Vaneck has a dream: to have one of his fuzzy controllers steer a boat autonomously across the Atlantic Ocean, perhaps retracing the course of Lindbergh's flight. "We push it off here, it drives to France, a little sign pops up HI FROM MIT!, and it turns around and comes back," he says, kneeling down on the dock to retrieve his toy boat.—*PETER TYSON*

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Trends

Digital Signatures

When John Hancock signed the Declaration of Independence in 1776, he wrote his signature large—so large, the saying goes, "that King George would be able to read it without his spectacles."

Hancock's signature was unique. But were the Revolution to happen today, a modern-day counter-revolutionary could wreak havoc simply by typing Hancock's name at the bottom of a message pledging allegiance to the King and posting it on the Internet.

Proving authenticity in the computer age isn't just a matter of idle speculation. Consider these cases:

• In the fall of 1993, a student at Dartmouth University sent forged electronic mail saying that a midterm exam in professor David Becker's course on Latin American politics was canceled because Becker had a family emergency. The mail message was sent at 11:00 p.m. the night before the test. Only half of the class showed up for the exam the next morning.

• In October 1994, someone broke into the computer account of Grady Blount, a professor of environmental science at Texas A&M University, and sent out racist electronic mail to more than 20,000 people on the Internet. It was by no means a harmless practical joke. "We received death threats... as the result of that hate mail that was sent out under my name," recalls Blount, who says that even his research grants were put in jeopardy as a result of the incident.

• In the spring of 1995 and then again in 1996, a computer program called PKZIP30B.EXE was uploaded to many computers on the Internet. The program appeared to have been sent by PKWare as its 3.0B release of PKZIP, a popular disk-compression program. But when unsuspecting users downloaded and tried to run the program, they found that the program, which had been sent by an impostor, actually erased their hard disks.

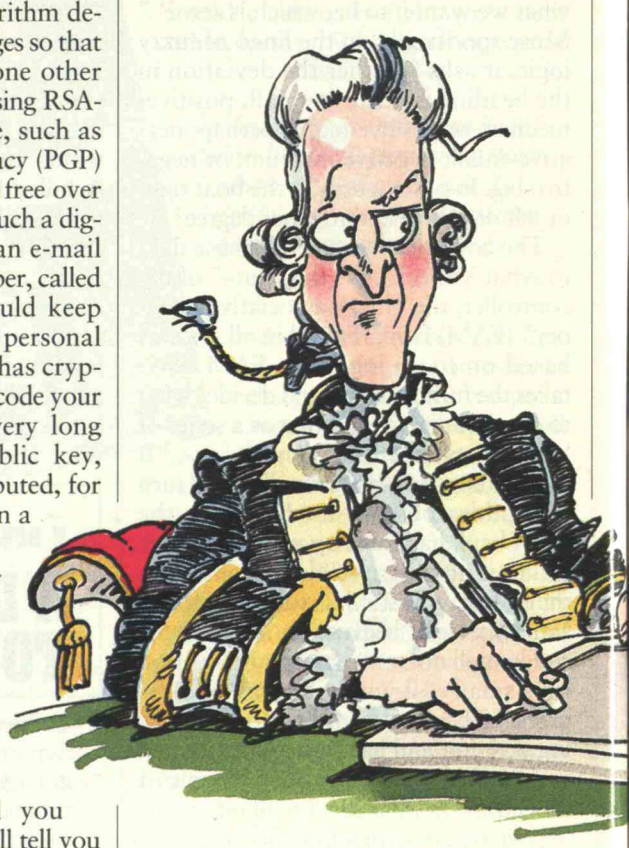
Now a new kind of computerized safeguard promises to put the brakes on forgery once and for all. The technique is called a digital signature and is based on an algorithm discovered in 1977 by three professors of computer science at MIT: Ronald Rivest, Adi Shamir, and Leonard Adleman.

This so-called "RSA" algorithm describes a way to encrypt messages so that they cannot be read by anyone other than the intended recipient. Using RSA-based cryptography software, such as the popular Pretty Good Privacy (PGP) program, which is distributed free over the Internet, you could create such a digital signature by encrypting an e-mail message with a very long number, called a secret key, which you would keep safely locked away in your personal computer. Anyone who also has cryptography software can then decode your message by using another very long number, your matching public key, which would be widely distributed, for example, on the Internet or in a phone book.

The power of digital signatures is that they are extremely precise. If someone alters the signed message even slightly—adding a sentence or even changing a period to a comma—the signature will no longer verify. The digital signature algorithm can't tell you what's been changed, but it will tell you that the message you have just downloaded has been tampered with.

Despite their technical sophistication, digital signatures are today used by only a small group of computer security professionals. One stumbling block preventing more widespread deployment has been the lack of a reliable system for distributing public keys and for verifying that your public key really belongs to you, and not to a digital impostor. Indeed, a recent check of the PGP public key server at MIT listed among its more than 13,000 public keys obviously fake ones for William Clinton, Albert Gore, and Hillary Rodham Clinton, the latter with the malicious e-mail address of bimbo@whitehouse.gov.

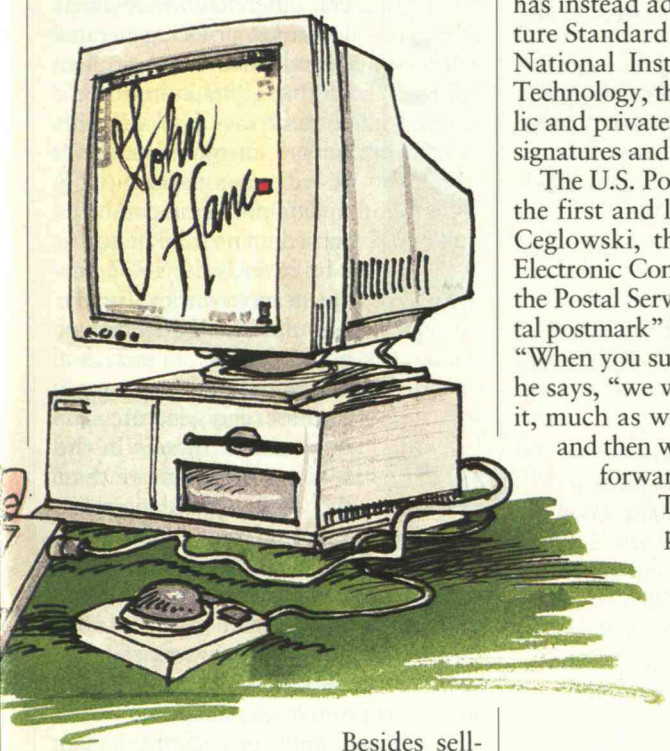
To help solve this problem, new organizations called Certificate Authorities are springing up. VeriSign, the largest, will certify that a public key really belongs to the person or company whose name is on it. The cost for VeriSign's corporate service is $295 for the first year, $95 for annual renewals. For that price, VeriSign conducts a background check of the organization and then signs the firm's corporate key with its own VeriSign master key. This creates a certificate chain: your copy of the World Write word processor would be signed by World Write's key, and World Write's key would be signed by VeriSign. By verifying the signatures, you can ascertain that the program you have just downloaded is authentic and unmodified.



How does a consumer verify VeriSign's key? They don't have to: copies of it are already built into many popular programs used for accessing the Internet, including Netscape Navigator and Microsoft's Internet Explorer. Each

ILLUSTRATION: JON McINTOSH

time Explorer downloads a program from the Internet, it automatically checks the downloaded program to see if it has been digitally signed. If so, Explorer prints the name on the certificate. If not, Explorer warns the user that the file that has just been downloaded might not have been created by the company that is claiming authorship.



Besides selling this service to companies, VeriSign plans to offer similar digital IDs for individuals. The purpose of these certificates, says VeriSign's president Stratton Sclavos, is to let people on the Internet prove their own identities. Consider the hypothetical case of our modern-day John Hancock. When the Continental Congress placed its Declaration of Electronic Independence on the Internet, Hancock would add his own digital signature to the bottom and a copy of his public key. His public key, in turn, would be signed by VeriSign. Some turncoats trying to discredit Hancock's good name could encrypt a bogus message and make up their own public key, but they couldn't get it signed by VeriSign.

Another obstacle to advancing the use of digital signatures is the development of competing standards. Indeed, the U.S. government has decried the RSA algorithm because while the Clinton administration is eager to spread the adoption of digital signatures, it is concerned that cryptography can also be used by drug dealers, terrorists, and organized crime to defeat court-authorized wiretaps. It has instead adopted the Digital Signature Standard (DSS), developed by the National Institute of Standards and Technology, that allows the use of public and private keys, but only for digital signatures and not for encryption.

The U.S. Postal Service is likely to be the first and largest user of DSS. Ken Ceglowski, the agency's manager of Electronic Commerce Services, says that the Postal Service plans to offer a "digital postmark" before the end of the year. "When you submit an e-mail message," he says, "we will time- and date-stamp it, much as we do with physical mail, and then we will digitally sign it and forward it to the recipient."

The Postal Service will probably get into the Certification Authority business as well. But VeriSign's Sclavos isn't worried about the competition. "Clearly, we are first to market," he says. "We have established very good relationships with Netscape and Microsoft and are achieving significant market share."

But the Postal Service has an advantage that VeriSign can't touch: the mail-fraud statutes, which would make it a felony for a person to obtain a Postal Service digital ID under a fake name. That, combined with the thousands of Postal Service outlets long ensconced in virtually every town in the country, will make the government a formidable competitor.

—*SIMSON L. GARFINKEL*

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DNA Fingerprinting Gets a Reprieve

"It will be long before a... jury will consent to convict a man upon the evidence of his fingerprints... it will not be easy to submit it in a form that will amount to legal evidence."

This statement was made in an 1892 review of Sir Francis Galton's system for identifying people based on their fingerprints. But it could just as easily have been plucked from contemporary legal commentary or from the daily headlines debating the reliability of DNA "fingerprints" in a murder trial.

Today we simply take for granted that fingerprints are unique to an individual. Now a report from the National Research Council (NRC) says it's time for the courts to accept DNA profiles—generated from blood, semen, saliva, hair, or skin samples found at a crime scene and compared with DNA collected from a suspect—as positive identification as well.

Since the first DNA profiles were entered into evidence in U.S. criminal court in 1986, they have been used as evidence in thousands of cases. But scientists have disagreed over their reliability in linking a suspect to a crime, thus leaving it to the court system and juries to decide. As it stands now, some courts accept a simple statement of a DNA match, while others demand a rigorous statistical analysis of the chance a match may be random.

The chief objective of the current NRC committee was to clear up controversy surrounding an earlier NRC report, issued in 1992. Bruce Weir, a statistician from North Carolina State University in Raleigh and a critic of the 1992 report, says the earlier report posed "a tremendous barrier in this country to the use of a more rational system of reporting DNA forensic results."

In the new report, the committee effectively repeals the most controversial recommendation from the 1992 committee, the so-called "ceiling principle," which stated that not enough was known about

DNA sequences to make an accurate calculation of the frequency with which particular sequences appear in various ethnic groups. For example, if scientists looked at the DNA of a group of Mexican-Americans, they would find that a small percentage, at most, would have the same pattern at any one chromosome location. But since scientists had not done sampling and testing of the various ethnic groups by 1992, the committee hedged and called for an interim "ceiling" of 10 percent as the minimum number of people who would have that DNA pattern at a specific location. Such a ceiling was said to be a "conservative" standard, and would tend, if anything, to overestimate the number of people who might have the same genetic profile.



DNA evidence used in a recent trial induced the defendant to confess to a fatal stabbing. The man claimed blood found on his jeans and shirt was his own. But the DNA patterns obtained from the blood stains (middle columns) matched those of the victim (V), not the defendant (D). The probability that the blood belonged to anyone but the victim was 1 in 50 million.

False Ceiling

Immediately after the report appeared, many population geneticists attacked the "10 percent" ceiling as arbitrary and not firmly grounded in established genetic principles. In its place, the current NRC committee recommends that forensic scientists use minimum frequencies generated from databases of DNA profiles of ethnic populations, which have been collected since 1992.

Such databases allow forensic scientists to calculate the frequency of a given DNA profile based on well-established differences among races. In other words, if the perpetrator of a crime has been identified, say, as a Mexican-American, any DNA profile match figures would be compared with a Mexican-American database. If the ethnic group of a perpetrator is unknown, the committee recommends making separate calculations for each potential ethnic group. "This report improves the ability of the court to arrive at a correct decision about appropriate use of DNA evidence," says James Crow, chair of the committee and professor emeritus of genetics at the University of Wisconsin, Madison.

The premise of DNA profiling is simple. At certain locations on human chromosomes, geneticists have discovered that the sequence of DNA varies in discrete intervals from person to person. For example, at a given location, one person might have five copies of three of DNA's chemical subunits cytosine (C), guanine (G), adenine (A): CGACGACGACGACGA, while another person might have 100 copies of the same sequence. The person who has only 5 copies of the CGA sequence will have a smaller piece of DNA at that location than the person with 100 copies, distinguishing one person's DNA from another. Comparing the sequences at several different chromosomal locations, or loci, generates an individual DNA profile.

The 1996 committee's research says that even with only 5 chromosomal loci tested, a comparison of 58 million profiles in databases turned up no false matches. Moreover, since 1992, scientists have worked out the population frequencies of additional loci. In fact, as it now stands, profiles using 6 or 8 loci can generate random match figures in the billions—often more than the world's population.

Common sense would tell anyone that when the probability of a random match reaches into the billionths, it is safe to call such a profile unique. Yet the committee stopped short of exhorting the courts to accept DNA profiles as positive identification. Crow says scientists simply provide the data in support of the technology; it's up to society to decide when DNA profiling is reliable enough to identify an individual uniquely. It's simply a matter of case law catching up to science, he says.

"Judges are used to making these judgments; they just need the scientific community to reach consensus," says David Kaye, professor of law at Arizona State University and a member of the committee. "I believe this report will carry a lot of weight with judges because it is the voice of a consensus of scientific opinion. I can't tell you how long it will take," he says, "but once one court writes an opinion it will snowball from there. The court system respects precedence."

—KARYN HEDE GEORGE

PHOTO: CELLMARK DIAGNOSTICS

Gone Today, Hair Tomorrow

Heads up, sufferers of baldness: genetics research may soon lead to novel drugs that provide alternatives to toupees, hair transplants, and even the newest tonic, Rogaine (which, according to studies conducted by its maker, Upjohn, results in moderate to dense hair growth in only about one-quarter of male and one-fifth of female users possibly by stimulating atrophied hair follicles). Researchers are now taking aim at the genetic roots of male-pattern balding, which accounts for 95 percent of hair loss and afflicts 40 million men—and, despite its name, some 20 million women—in the United States.

Scientists have long suspected that the condition, called androgenic alopecia, had a genetic basis. Now, recent studies of a group of men in the Caribbean who never experienced baldness have not only confirmed the theory but provided clues for possible cures as well.

The nonbalding male islanders attracted attention because, as a result of a genetic mutation that caused them to have ambiguous genitalia, they were raised as girls until they reached puberty and developed deep voices, muscles, and discernible penises. Studies revealed that these individuals failed to produce normal amounts of an enzyme called 5-alpha reductase, which converts the male hormone testosterone into a highly active form called dihydrotestosterone (DHT). Besides retaining a thick head of hair even as they reached old age, the men also never suffered from acne or prostate enlargement.

Subsequent investigations of DHT in other populations revealed that when the energized testosterone attaches to receptors on hair follicles, the follicles weaken and shrivel. As a result, men sprout bald spots, while women's hair thins overall.

Based on these observations, several biotechnology companies have been investigating new drug therapies that aim to prevent DHT from binding to hair follicles. One new antibalding drug started life as a medication designed to shrink swollen prostate glands. Although DHT causes hair follicles to atrophy, it has the opposite effect in the prostate, where DHT triggers prostate enlargement. The drug, which structurally mimics testosterone, ties up the 5-alpha reductase enzyme in the prostate and thereby prevents it from making DHT from the actual testosterone.

Called finasteride, the drug shrinks the prostate gland, but as a side-effect, it also grows hair. Studies show that the barren hair follicles, which are shriveled but still alive and connected to a blood supply, are rejuvenated once the enzyme is tied up and DHT is removed.

To test finasteride's effectiveness as a balding remedy, Merck Research Labs in Rahway, N.J., has conducted clinical trials in 3,000 men. In volunteers taking one-milligram tablets daily (one-fifth the dose needed to control prostate enlargement), 59 percent showed significant hair growth by six months. According to physician Keith Kaufman, director of clinical research, Merck plans to file a New Drug Application with the Food and Drug Administration (FDA) by the end of 1996 to market finasteride as an antibalding treatment.

Other companies are targeting the underlying causes of balding with so-called antisense technology, which uses small nucleotides, the building blocks of DNA, to inhibit specific functions at the genetic level. For example, Dyad Pharmaceuticals of Columbia, Md., is investigating the use of an antisense drug designed to prevent a segment of messenger RNA from carrying out its normal task of manufacturing proteins, in this case those that make up 5-alpha reductase. The drug works by binding to the messenger RNA, thereby preventing it from attaching to a specific enzyme that tells it to begin 5-alpha reductase production.

According to biochemist Glenn Hoke, vice-president of research at Dyad, the company hopes to begin clinical trials in 1997 with a formula that can be applied locally as a cream on the scalp, rather than risk any potential systemic side-effects of drug delivered through the blood stream. He claims that unlike Merck's finasteride, which was originally designed to inhibit the type of 5-alpha reductase linked to prostate enlargement, Dyad's antisense drug will not only act locally—targeting hair follicles only—but it will also bind to a more specific type of 5-alpha reductase that is connected only to baldness. Conversely, finasteride given in tablet form "can bind to 5-alpha reductase anywhere in the body and cause problems in the long term," he says, including dimin-

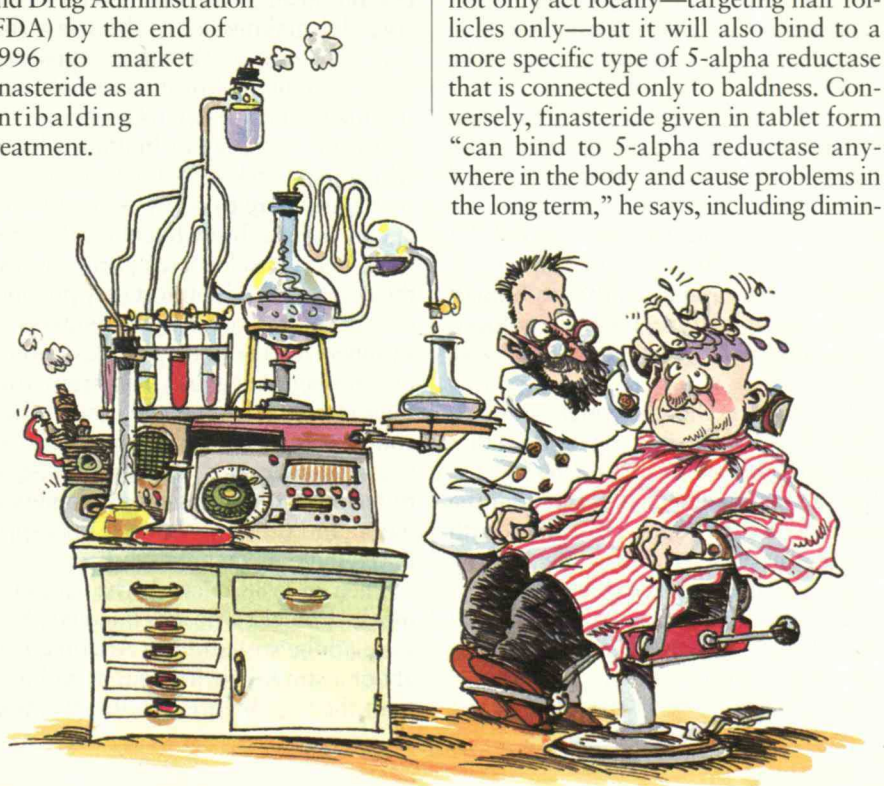


ILLUSTRATION: JON McINTOSH

ished sperm quantity and loss of libido.

Kaufman counters that some patients prefer swallowing a pill once a day instead of smearing something on their scalp and worrying about it rubbing off or looking slick. "Taking a pill may be more convenient and guarantees complete absorption," Kaufman says. Moreover, he says that Merck's finasteride studies showed no safety problems. However, based on animal studies of the drug, Merck does advise women trying to get pregnant to avoid being impregnated by men taking finasteride because the drug could potentially interfere with genital development of male fetuses. Similarly, women taking finasteride themselves risk a slight chance of a feminized male fetus should they become pregnant.

Researchers at Genta, Inc., of San Diego, believe that targeting the DHT receptor on the hair follicles instead of 5-alpha reductase is the best approach. According to Robert Brown, a biologist at Genta, testosterone can also attach to the DHT receptor, although not as strongly as DHT, and cause hair loss, although not as severely as DHT. Knocking out 5-alpha reductase removes DHT from the hair-loss picture, but not testosterone. To totally prevent hair loss, he says, the DHT receptor needs to be blocked.

Genta has therefore created a formulation of proprietary antisense nucleotides that bind to DNA at the hair follicles and keep DHT from attaching. The company plans to start clinical testing in early 1997 to determine actual hair growth results, but thus far has shown that in human scalp cells in culture, the drug reduced the binding of DHT to hair follicles by 85 percent.

Like Dyad, the company hopes to develop a lotion containing the drug that will penetrate the scalp and act locally. But the inconvenience of applying the cream could be reduced. Studies with fluorescent dyes show that Genta's drug enters cell nuclei and remains there for several days, says Brown, suggesting that users may be able to apply the drug perhaps just once every other day.

—*Carol Potera*

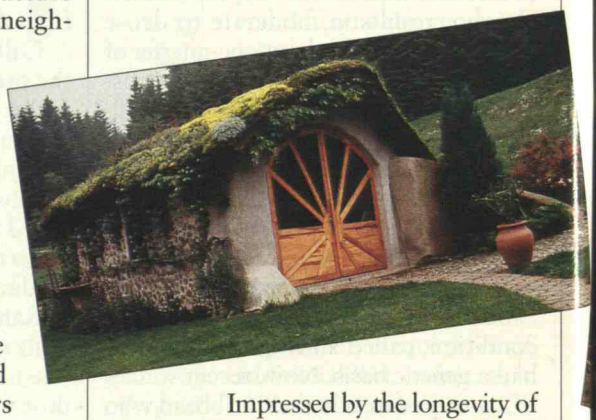
Houses of Straw

The first little pig who built his house with straw in *The Three Little Pigs* could have outwitted the big bad wolf by using the plans for Bob Munk's 3,800-square-foot home. Indeed, although a close inspection of the framework reveals an interior made entirely of straw, the earthen-plastered structure appears as rugged as any of its neighbors in the juniper-covered hills of Santa Fe, N. Mex.

Munk may be the first on his block to own a straw house, but he is not alone in choosing the novel building material. In fact, his home is one of nearly 200 straw structures built in the United States during the past 10 years. Moreover, the trend itself is not entirely new, but rather the revival of a practice that started when early Nebraska settlers began using the material in the late 1800s. Without enough trees for timber, pioneers in the Sand Hill region of the state originally used sod to construct their homes. But a new invention of the era, the steam baler, prompted them to consider making use of the straw that was left over from their grain harvests.

The resourceful frontierspeople used the mechanical baler to compress the straw into rectangular building blocks, which they stacked and reinforced with string and wire to construct crude and craggy houses. But while the bale structures were considered temporary at first, the durability and comfort they provided during Nebraska's extreme winters and summers led the settlers to plaster them over for permanent use. The straw structures rapidly proliferated during the next couple of decades, but by the 1930s, the use of straw bale in construction began to die out with the rise in availability of wood and other traditional mass-produced building materials.

Then, in 1988, Matts Myhrman, a former hydrologist who was building small-scale adobe structures in Arizona, read about a straw-bale house that had been built the year before in Gila, N. Mex., for just $7.50 per square foot, which was a far cry from the typical $45-to-$75-per-square-foot cost of conventional wood-frame homes. Interested in learning more about straw as a low-cost building material, Myhrman and his wife, Judy Knox, visited the Sand Hill straw structures, which have remained standing since the turn of the century.



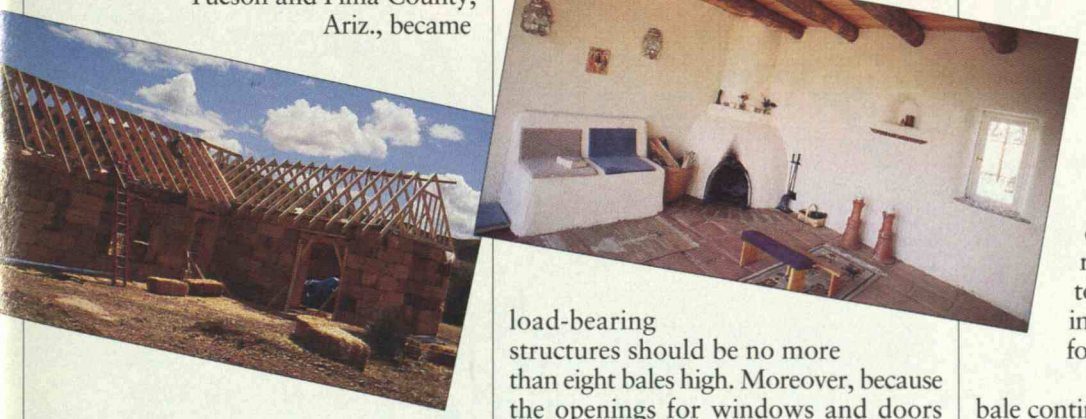
Impressed by the longevity of the straw homes, the couple decided to share their discovery "with anyone who would listen," says Myhrman. When a former colleague at the University of Arizona saw Myhrman's slides of the Nebraska houses, he asked Myhrman for help in building an office/bunkhouse for one of his field projects. With little more to go on than interviews with former residents of the Sand Hill buildings and a paper on bale structures by a Nebraska folklorist, Myhrman set to work. Spurred by the overwhelming number of people who volunteered to help and the ease with which they completed the structure, Myhrman and Knox founded Out on Bale, an education and resource center to promote and support the use of straw as a building material.

Myhrman claims many middle-income families could overcome the financial difficulties of building and owning a home if they chose inexpensive straw bale. Besides saving on material costs, he says, straw-home builders could realize even greater savings in utility costs over the life of the home. Indeed, when the straw-bale walls are plastered, he explains, they provide two-and-a-half

PHOTOS: BILL STEEN

times more insulation than a wood-framed house with conventional insulating materials.

Despite the advantages, most people are understandably reluctant to build their homes with straw, Myhrman says. To help ease concerns of builders and buyers alike, he and other advocates have been lobbying to append the Uniform Building Code, one of the most widely used domestic building standards, to incorporate guidelines for building with straw. As a result, last year Tucson and Pima County, Ariz., became the first major jurisdictions to include standards for the use of straw in constructing load-bearing structures, that is, buildings in which the bales form the walls and support the roof.



Construction with straw, popular in the 1800's, is undergoing a revival today with the help of new building codes that specify the height of walls, the locations of doors and windows, and techniques for applying roofs and plastering interior and exterior walls.

"We wanted to establish a prescriptive standard that spells out the idiosyncrasies of bale so that people know what building officials want to see in their plans and there are no surprises," says Myhrman. For example, because of the compressibility of the bales, builders are advised to limit structures to one story.

In addition to their use in load-bearing construction, bales can also be valuable merely as insulation between walls in traditional post-and-beam construction. Both methods recommend using dry, well-compacted, consistently sized and shaped straw bales—approximately 4 feet long by 2 feet wide by 1-1/2 feet high—that weigh some 80 pounds apiece and are held together by three ties of wire or baling twine.

The differences between the two methods arise in design. With the post-and-beam method, "the sky is the limit" in terms of height, says Myhrman. However, to avoid compression problems, load-bearing structures should be no more than eight bales high. Moreover, because the openings for windows and doors tend to weaken a wall's strength, a standard rule of thumb requires that openings should be at least one-and-a-half bale lengths away from a corner or from each other. The bales should be laid flat and staggered, like bricks, and then pinned with hardwood or steel rods. After checking that the walls are straight and vertical, wooden roof plates or concrete beams should be attached to the top of the walls.

Finally, before the wall can be finished with stucco or plaster, the bales must compress in response to the weight of the roof/ceiling system. A builder can either wait anywhere from 3 to 10 weeks for this to happen naturally or compress the bales by pulling down the roof plates or concrete beams mechanically.

Besides slowly gaining support from building officials, the straw-construction revival is getting a boost from a most unlikely catalyst: salmon fishermen in California's Central Valley. Members of the Pacific Coast Federation of Fishermen's Association became alarmed about the fate of the region's salmon when California rice growers began the practice of diverting water from local streams to remove leftover straw from their rice fields. Rather than fight the fishermen, the California Rice Industry Association decided to join them in an effort to eliminate the need for irrigation by trying to find a market for the leftover straw.

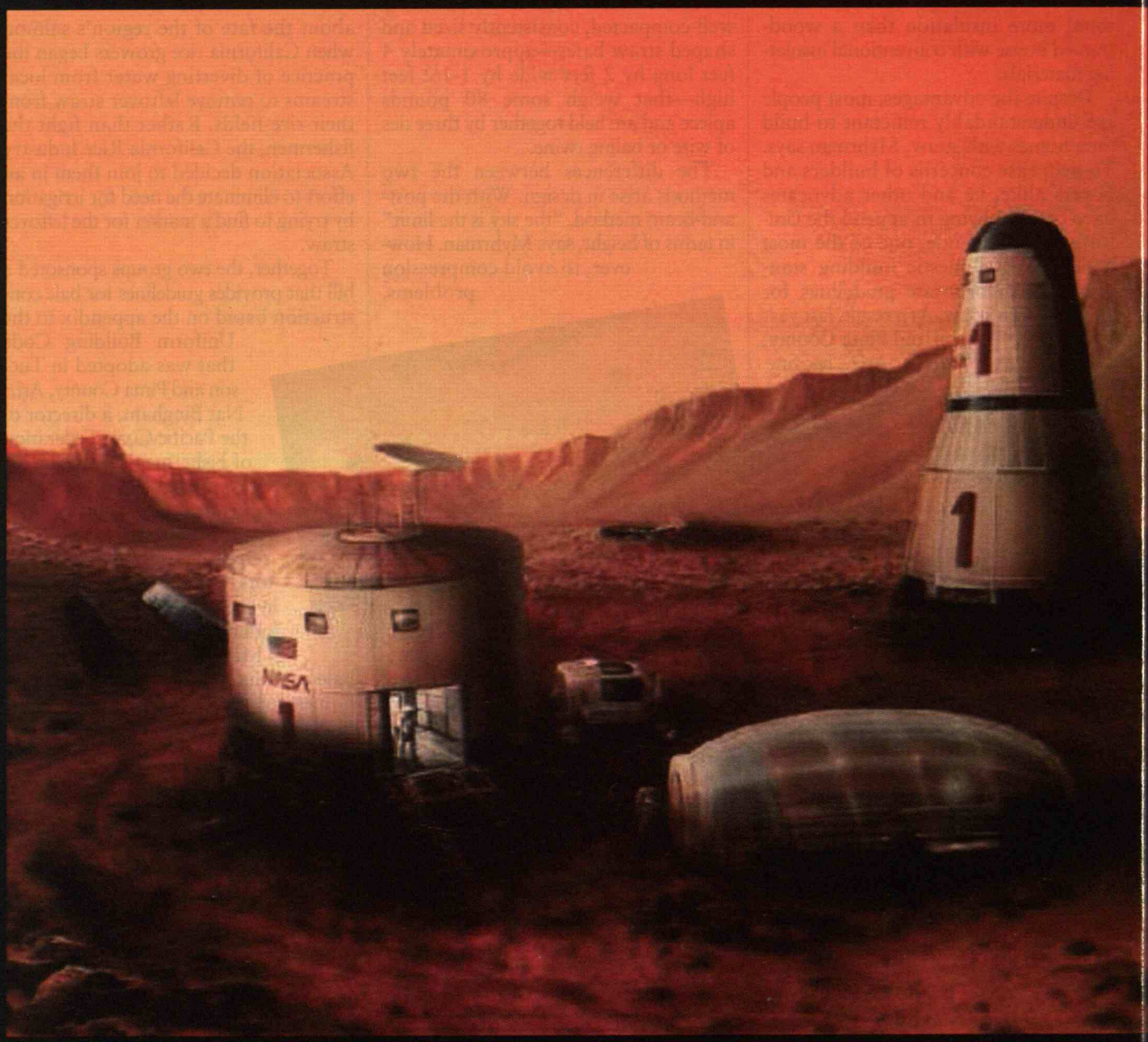
Together, the two groups sponsored a bill that provides guidelines for bale construction based on the appendix to the Uniform Building Code that was adopted in Tucson and Pima County, Ariz. Nat Bingham, a director of the Pacific Coast Federation of Fishermen's Association, says the legislation, which was intended to "demystify" bale construction by serving as a reference for building inspectors, has already been adopted in varying degrees by four California counties.

Meanwhile, building with bale continues. With a mission to build homes for the homeless, Habitat for Humanity (based in Americus, Ga.) recently completed its first straw-bale structure, a 1,200-square-foot residence for a family of four in Silver City, N. Mex. Venturing further afield, last year Myhrman, under the auspices of the Adventist Development and Relief Agency, traveled to the urban slums of Mongolia, where people live in tar-paper shacks in temperatures of 50 degrees below zero, to build two prototype structures from straw. Subsequently, a colleague of Myhrman's returned to Mongolia earlier this year to build a preschool with straw.

Pointing to such successes, today's bale advocates counter skeptics who compare their work with that of the three little pigs, simply by saying, "Don't let pigs build your house."

—*STEPHANIE V. GREPO*

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THE AUTHOR'S LOW-BUDGET PLAN FOR LANDING HUMANS ON MARS COULD BE REALIZED WITHIN A DECADE IF A VISIONARY POLITICAL LEADER OR A ROBUST INTERNATIONAL PARTNERSHIP TAKES UP THE CAUSE. FAILING THAT, WOULD A $20 BILLION CASH PRIZE INTEREST ANYONE?

By Robert Zubrin

MARS on a Shoestring



The planet Mars is a world of spectacular mountains three times as tall as Mount Everest, canyons three times as deep and five times as long as the Grand Canyon, vast ice fields, and thousands of kilometers of mysterious dry riverbeds. The planet's unexplored surface may hold unimagined riches and resources for future humanity, as well as answers to some of the deepest philosophical questions that thinking men and women have pondered for millennia. ✦ Mars became an even more tantalizing destination in August 1996 when NASA scientists announced that an Antarctic meteorite—apparently from Mars—contained organic molecules and

formations suggestive of microbes. If these are the remains of life, they may well be evidence of only the most modest representatives of an ancient Martian biosphere whose more interesting and complex manifestations are still preserved in fossil beds on the planet. To find them, though, will take more than robotic eyes and remote control. In fact, all that Mars holds will remain beyond our grasp until men and women—agile, autonomous, intuitive beings—walk upon its surface.

The usual proposals for launching a human mission to Mars, be they from the 1950s or the 1990s, call for enormous spaceships hauling to Mars all the supplies and propellant required for a two- to three-year round-trip mission. The size of these spacecraft means that they must be assembled in earth orbit—they're simply too large to launch from the earth's surface in one piece. Thus a virtual "parallel universe" of gigantic orbiting dry docks, hangars, cryogenic fuel depots, checkout points, and crew quarters must also be placed in orbit to enable assembly of the spaceships and storage of the vast quantities of propellant.

Such a mission to Mars would be exceedingly costly and would have to incorporate orbital construction and other technologies that won't be available for another 30 years. One such plan, known as the "90-Day Report," developed in response to President Bush's 1989 call for a Space Exploration Initiative, produced a cost estimate of $450 billion. Sticker shock in Congress doomed Bush's program and has deterred most people from seriously considering a humans-to-Mars program ever since. Continuing this trend, President Clinton announced in September that he would postpone any such mission until its cost could be justified.

Yet landing humans on Mars requires neither miraculous new technologies nor vast sums of money. We don't need to build futuristic "Battlestar Galactica" spaceships to go to Mars. We can reach the Red Planet within a decade with relatively small spacecraft launched directly to Mars by boosters embodying the same technology that carried astronauts to the moon more than a quarter-century ago. We simply need to use some common sense to travel light and "live off the land," just as was done by nearly every successful program of terrestrial exploration in history.

Consider what would have happened if Lewis and Clark had decided to bring all the food, water, and fodder needed for their transcontinental journey. They would have required hundreds of wagons, horses, and drivers, creating a logistics nightmare that would have sent the costs of the expedition beyond the resources of the America of Jefferson's time. Is it any wonder that Mars plans that don't make use of local resources manage to ring up $450 billion price tags? Living off the land is not just the way the West was won, it's the way the earth was won, and it's also the way Mars can be won.

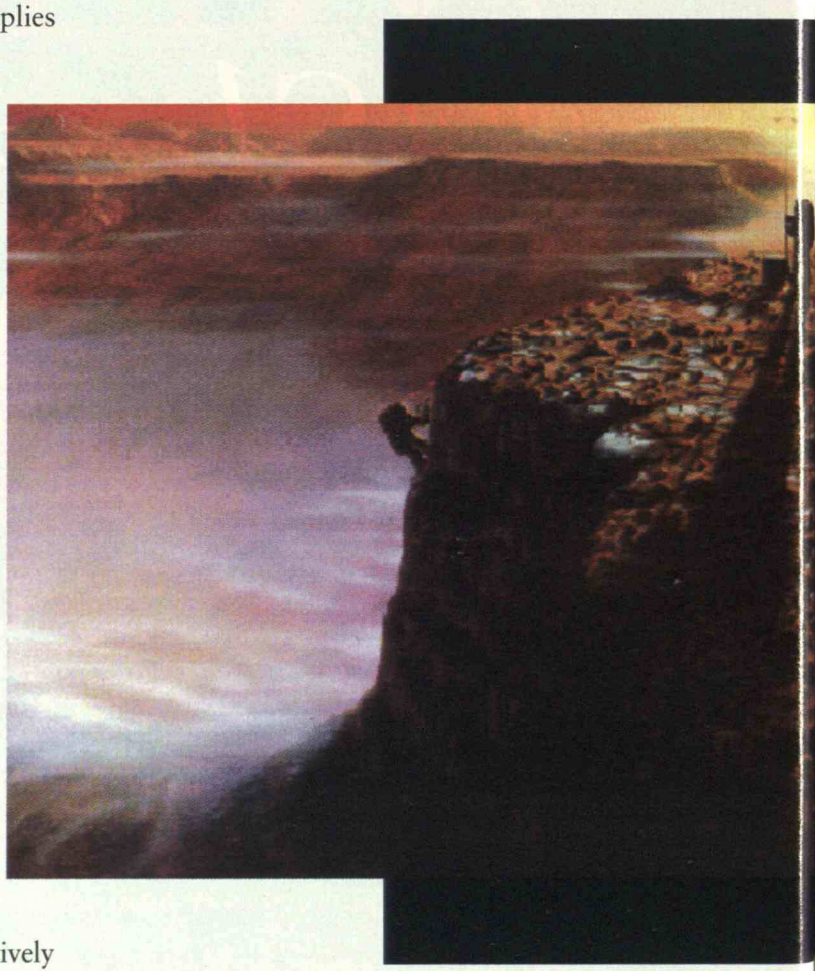


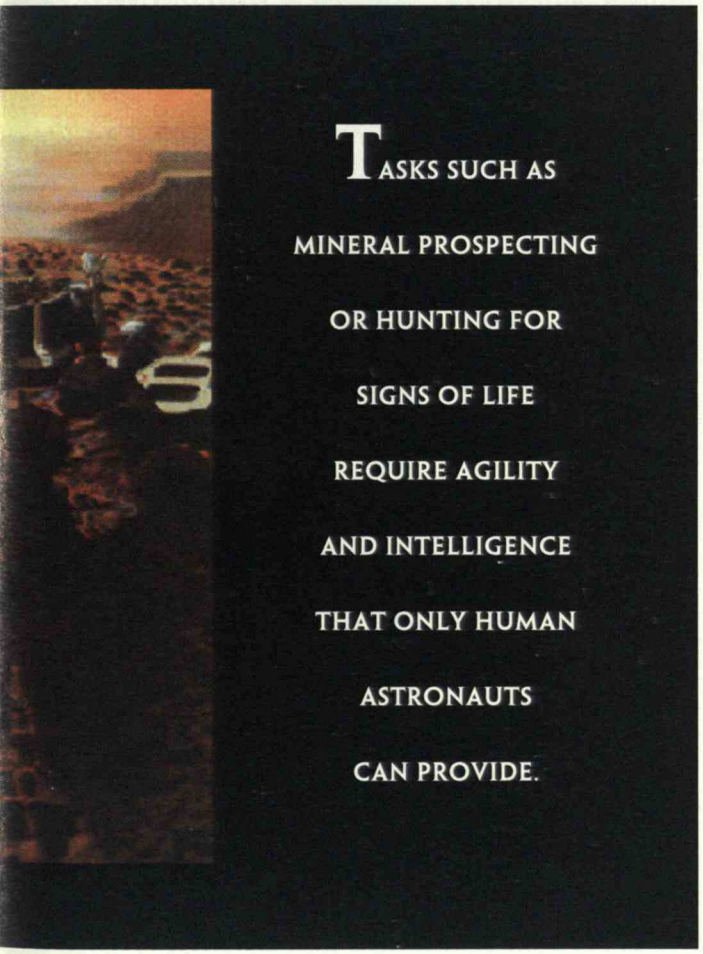
ILLUSTRATION: PAT RAWLINGS/NASA

Starting in the spring of 1990, I led a team of engineers and researchers at Martin Marietta Astronautics (now called Lockheed Martin Astronautics) in Denver in developing a live-off-the-land plan to pioneer Mars. Called Mars Direct, the plan discards unnecessary, expensive, and time-consuming detours: no need to assemble spaceships in low earth orbit; no need to refuel in space; no need for spaceship hangars at an enlarged space station; and no need for drawn-out development of lunar bases as a prelude to Mars exploration. Avoiding these detours saves perhaps 20 years and avoids the ballooning administrative costs that tend to afflict extended government programs.

If NASA were to undertake Mars Direct, the cost of

ROBERT ZUBRIN, formerly a senior engineer at Lockheed Martin Astronautics, is executive chairman of the National Space Society. He recently founded an independent aerospace R&D company, Pioneer Astronautics, in Lakewood, Colo. This article is adapted from his newly published book, The Case for Mars: The Plan to Settle the Red Planet and Why We Must *(The Free Press), written with Richard Wagner, former editor of* Ad Astra. *The home page for Zubrin's Mars Direct is at http://www.magick.net/mars.*

developing the required hardware would amount to roughly $20 billion, with each individual Mars mission costing about $2 billion once the ships and equipment were in production. Spent over a period of 10 years, $20 billion would represent only about 7 percent of the combined U.S. budgets for military and civilian space exploration. This money could also drive our economy forward, much as spending $70 billion (in today's dollars) on science and technology in the Apollo program contributed to rapid U.S. economic growth during the 1960s.



TASKS SUCH AS MINERAL PROSPECTING OR HUNTING FOR SIGNS OF LIFE REQUIRE AGILITY AND INTELLIGENCE THAT ONLY HUMAN ASTRONAUTS CAN PROVIDE.

Martian Chronicles

As clearly as can be envisioned from today's vantage point, here's how the Mars Direct plan would work:

AUGUST 2005. A new multistage "Ares" rocket fashioned from preexisting parts rests on the launch pad at Cape Canaveral, its dewy metal skin steaming in the morning sunlight. The booster reminds some people of the old Saturn V, the rocket that carried astronauts to the shores of the Sea of Tranquillity. The Ares booster has about the same heavy-lift capacity as a Saturn V, but at its heart are the workhorses of the past 20 years, all drawn from the space shuttle: four main engines and two solid-rocket boosters.

The engines ignite. Flame and smoke signal the start of a new space age as the Ares 1 hurtles skyward. High above earth's atmosphere the upper stage separates from the spent booster, fires its single hydrogen- and oxygen-burning engine, and hurls a crewless 45-tonne payload to Mars (one tonne, or metric ton, is about 2,200 pounds). This payload is the earth return vehicle—the ERV.

As its name implies, the ERV is designed to carry a crew of astronauts back from Mars to a splashdown in earth's waters. On its journey to Mars the ERV carries a small nuclear reactor mounted atop a lightweight truck, fuel-production equipment—an automated chemical processing unit and a set of compressors—and a few scientific rovers. The ERV's crew cabin includes a life support system, food, and other necessities to sustain a four-member crew on an eight-month journey back to earth. Though its two propulsion stages will consume some 96 tonnes of methane and oxygen on the return flight, the ERV heads for Mars carrying just 6 tonnes of liquid hydrogen, the feedstock for producing propellant on the planet's surface.

FEBRUARY 2006. Traveling at an average speed of about 27 kilometers per second, the ERV reaches Mars after a six-month trip. Upon arrival, the ERV uses its aeroshell—a blunt, mushroom-shaped shield—to slow itself down by plowing through the upper reaches of the thin Martian atmosphere. As the craft brakes, it falls into orbit, where it remains for a few days to allow the flight controllers to perform a final system checkout. Then, at dawn on a day free of dust clouds, with well-defined shadows and low winds at the landing site, the craft is steered down into the atmosphere for final entry. Using its aeroshell again, the ERV decelerates to subsonic speeds until a parachute, and finally a set of small rockets, can ease the vehicle to the surface.

Once settled on the rust-colored soil of Mars, the ERV gets to the business at hand: making fuel for the return flight out of thin air. A door pops open on the side of the squat ERV landing stage and the truck carrying the nuclear reactor trundles out. Using a small TV camera on board, mission controllers at NASA's Johnson Space Center in Houston slowly drive the truck a few hundred meters away from the landing site. Once the controllers maneuver the vehicle to an appropriate spot, a winch lifts the reactor from the truck's bed and lowers it into a small crater or other natural depression. The reactor kicks in and begins to energize the chemical processing unit—connected by a cable—with 100 kilowatts of electricity.

Martian air is 95 percent carbon dioxide gas. The chemical plant combines the carbon dioxide with the hydrogen, producing methane, which the ship will store for later use as rocket fuel, and water. This "methana-

tion" reaction is a simple, straightforward chemical process that has been practiced in industry since the 1890s. The reaction eliminates the need to store liquid hydrogen on the Martian surface: as the liquid hydrogen hauled from earth is used up, a second unit of the chemical plant splits the water produced by methanation into hydrogen and oxygen. The oxygen is stored as rocket propellant, while the hydrogen is recycled back into the chemical plant to make more methane and water. To obtain the ideal ratio of oxygen to fuel, a third unit splits Martian carbon dioxide into oxygen, which is stored, and carbon monoxide, which it vents as waste. After just six months, the chemical plant has used Mars's most freely available resource, its air, to leverage the 6 tonnes of liquid hydrogen brought from earth into 108 tonnes of methane and oxygen. This is enough to power the ERV's flight home and to provide 12 tonnes of fuel for ground vehicles.

SEPTEMBER 2006. Thirteen months after launch, a fully fueled earth return vehicle sits on the Mars surface, awaiting the arrival of a human crew. Having monitored every step of the chemical production process, engineers in Houston give the go-ahead for the next step in the mission: sending out small robots from the ERV to photograph and conduct seismic exploration of the surrounding terrain. Back on earth, the crew of the first human expedition can then pick an ideal landing spot. One of the ERV robots ambles over to the site and plants a radar transponder to help guide the crew to a safe touchdown when it arrives.

OCTOBER 2007. The Ares 3 launch vehicle, capped by a spacecraft called the *Beagle,* after the ship that carried Charles Darwin on his historic voyage, towers over the flatlands of the Cape, moments away from launch. Just a few weeks ago a similar booster, Ares 2, climbed into the skies over Florida. Carrying a backup ERV payload similar to the first, Ares 2 hurtles through space even as crowds gather to watch the launch of the ship that will convey the first four humans to Mars.

The main component of the *Beagle* is a habitation module that looks like a huge drum. The module stands about 5 meters high and measures about 8 meters in diameter. Consisting of two decks, each with 2.5 meters (about 8 feet) of headroom and a floor area of 100 square meters (about 1,000 square feet), it is large enough to comfortably house its crew. The "hab," as everybody calls it, contains a closed-loop life support system that recycles oxygen and water (similar to systems planned for the space station); whole food (irradiated for longer life and then canned or frozen) to last three years, plus a large supply of dehydrated emergency rations; and a ground car, pressurized so it provides a shirtsleeve environment and powered by an internal combustion engine that runs on methane and oxygen. Fully loaded, the hab weighs 25 tonnes.

The crew consists of a biogeochemist, a geologist/paleontologist, a flight engineer (who is also a top-notch pilot), and a jack-of-all-trades. This last crew member, who serves as mission commander, is primarily a flight engineer but can provide common medical treatment and understands the broad means and objectives of the scientific investigations.

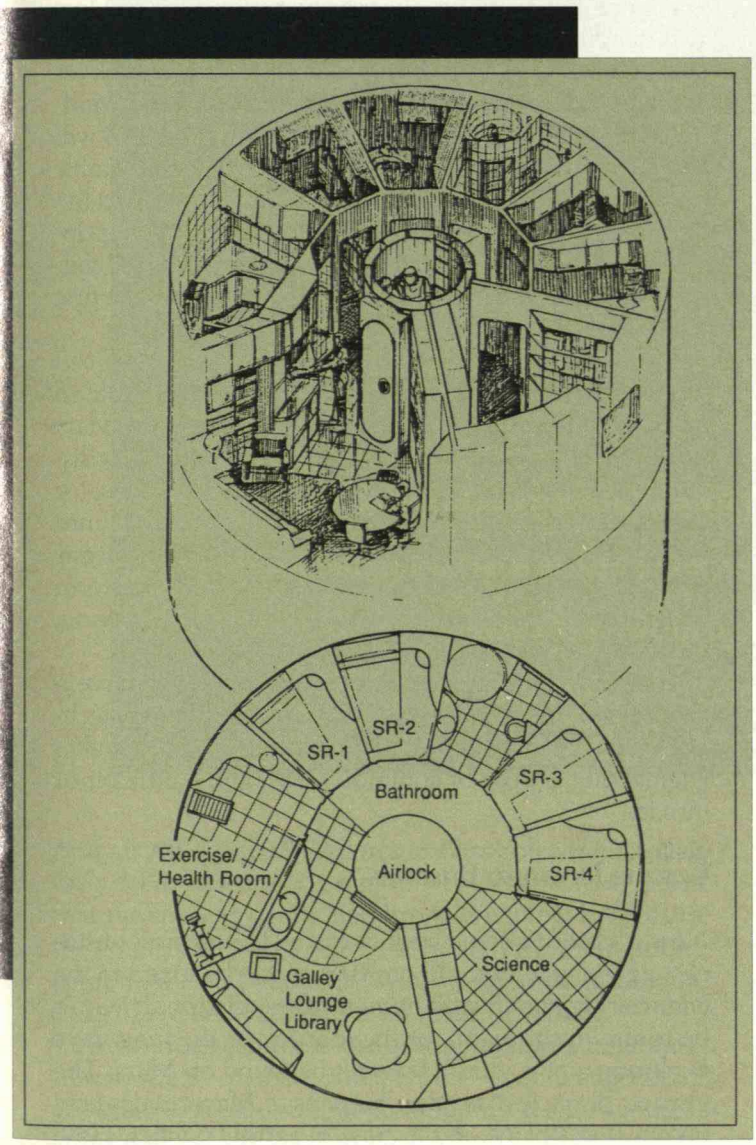
A "HABITATION" MODULE" WOULD SERVE AS THE LIVING QUARTERS AND WORK SPACE FOR MARS ASTRONAUTS BOTH EN ROUTE AND DURING THEIR 500-DAY STAY ON THE PLANET. THE MODULE WOULD CONTAIN FOOD FOR THREE YEARS.

On board the *Beagle*, the crew prepares for a journey that will return them home in two and a half years—about the same amount of time it took explorers centuries earlier to circumnavigate the globe. After the lower-stage engines erupt and the Ares 3 lifts off the pad, the upper stage fires its own engines, driving the hab to trans-Mars cruise velocity. Four humans are on their way to Mars.

APRIL 2008. On the 180th day of flight, the hab reaches Mars and aerobrakes into orbit. The crew intends to set the *Beagle* down at the landing site near the ERV that flew out to Mars in 2005. In the unlikely event that the *Beagle* misses the site, the crew has three backup options. First, it has aboard the hab a fueled, pressurized rover with a one-way range of nearly 1,000 kilometers. So long as the crew is within that distance of the landing site, it can still get to the ERV by driving overland. If some disaster causes the *Beagle* to miss the mark by more than 1,000 kilometers, the second backup can be brought into play. This is the ERV launched by Ares 2, which, since it has traveled on a slower trajectory than the *Beagle*, is now following the crew to Mars. Even if the crew lands the hab on the wrong side of the planet, this second ERV can be maneuvered to land near them. Finally, as a third-level backup, the crew lands with sup-

plies for three years—if worse comes to worst, the four can just tough it out on Mars until additional supplies and another ERV can be sent out in 2009.

The landing, however, is right on target. Though they have studied images of the landing site in detail, nothing can prepare the crew for the sight of the Martian landscape stretching before them. The soils are rust colored, littered with sharp-edged rocks, large and small. In the distance are small hills and dunes. The scene is akin to the deserts of America's Southwest, save for the skies, which are a constant ruddy salmon color. Although there's an immense amount to be done just after touchdown, the crew members take a moment to savor the knowledge that no human has ever gazed out on this vista.



With the *Beagle* safely down, the Ares 2 ERV lands some 800 kilometers away (distant enough to open a new site for exploration, but close enough to serve as a backup to the first ERV), where it begins filling itself with propellant. It will be used as the ERV for the second human expedition, which will arrive in 2010, along with another ERV that will open up Mars landing site number three.

The crew of the *Beagle* will spend 500 days on the Martian surface. Unlike conventional Mars-mission plans based upon orbiting mother ships with small landing parties, Mars Direct places all the crew on the surface, where they can explore and learn how to live in the Martian environment. No one is left in orbit, vulnerable to the hazards of cosmic rays and zero-gravity living, so there is no strong motive for a quick departure.

With such a substantial amount of surface time, the crew can pursue projects that will vastly expand our knowledge of the planet and pave the way toward future exploration and, eventually, human settlements. Geologic surveys will start piecing together the planet's climatic history, perhaps revealing how and when it lost its warm, wet climate. Such surveys will also prospect for useful minerals and other resources. Mars has undergone the same sorts of volcanic and hydrologic processes that produced a multitude of mineral ores on earth, and virtually every element of significant interest to industry is known to exist on the Red Planet.

Above all, astronauts will seek out easily extractable deposits of water ice or, better yet, subsurface bodies of geothermally heated water. Mars is known to possess veritable oceans of water frozen into its soil as permafrost. If discovered in a usable form, water would free future Mars missions from the need to import hydrogen from earth for making rocket propellant, and would make possible large-scale greenhouse agriculture once a permanent Mars base was established. An inflatable greenhouse will be brought along for experimentation. The exploration that will seize the attention of earth, though, will be the search for Martian life.

Images of Mars taken from orbit show dry riverbeds, indicating that Mars once had flowing water on its surface—that it was once a place potentially friendly to life. The best geologic evidence indicates that this warm and wet period lasted through the planet's first billion years, considerably longer than it took life to emerge on earth. Current theories hold that the evolution of living from nonliving matter is an orderly process with a high probability of occurring whenever conditions are favorable. If this is true, then chances are life should have evolved on Mars.

When NASA announced its discovery of possible microbe fossils last August, the agency termed the evidence compelling but not conclusive. Further investiga-

tions by the first human explorers could have a profound impact on our understanding of our place in the cosmos. Conclusive evidence of Martian life, present or fossilized, would strongly suggest that life abounds in the universe. On the other hand, if we find that Mars, despite its once clement climate, never produced any life, we would have to accept the possibility that life on earth is a fluke. We could be virtually alone in the universe.

The search for life will be intensive, and there are many different places to look. The planet's dry riverbeds and lake beds may have been the last redoubts of a retreating Martian biosphere, and thus might contain fossils. Water ice sheets covering the planet's north pole could hold well-preserved remains of actual organisms. Geologically heated ground water beneath the surface—if it exists—may yet harbor life. By studying the differences from, and similarities to, species that evolved on our own planet, we could begin to discern what is incidental to earth life and what is fundamental to the very nature of life itself. The results could lead to breakthroughs in medicine, genetic engineering, and all the biological and biochemical sciences.

To search for resources and signs of life, the first explorers on Mars will have to range across the Martian landscape. The pressurized ground rover will have enough fuel to rack up more than 24,000 kilometers on the odometer in the course of numerous week-long sorties. As the rover crew travels, it will leave behind small remote-controlled robots that will allow the base crew, and those of us on earth, to continue exploring a multitude of sites via television.

September 2009. After a year and a half on the Martian surface, the astronauts clamber aboard the ERV and blast off, receiving a hero's welcome on earth some six months later. They leave behind Mars Base 1, consisting of the *Beagle* hab, a rover, a greenhouse, power and chemical plants, a stockpile of methane/oxygen fuel for use by follow-up missions, and nearly all of their scientific instruments.

May 2010. Shortly after the first crew returns to earth, a second crew reaches Mars in Hab 2 and lands at what will become Mars Base 2. The crew of the second mission will spend most of its time exploring the territory around its own site but will probably drive over to the old *Beagle* at Mars Base 1 to continue scientific investigations begun there.

Every two years, a pair of Ares boosters will blast off, one delivering a hab to a prepared site, the other an earth return vehicle to open up a new region for the next mission. Over time, a network of exploratory bases will be established, turning large areas of Mars into human territory. But eventually one base region will be chosen as the site for building an actual Mars settlement. Ideally, this will be situated above a geothermally heated reservoir to supply hot water and electric power. In time, a set of structures resembling a small town will slowly take form.

The high cost of transportation between earth and Mars will create a strong financial incentive to find astronauts willing to extend their tours to four years, six years, and more. But over time, the transportation costs to Mars will steadily fall, driven down by new technologies and competitive bids from contractors offering to deliver cargo to support the base. Photovoltaic panels and windmills manufactured on site from Martian materials will add to the power supply, and locally produced inflatable plastic structures will multiply the town's pressurized living space. With more arrivals and longer stays, the population of the town will grow. In the course of things, children will be born, and families raised, on Mars—the first true colonists of a new branch of human civilization.

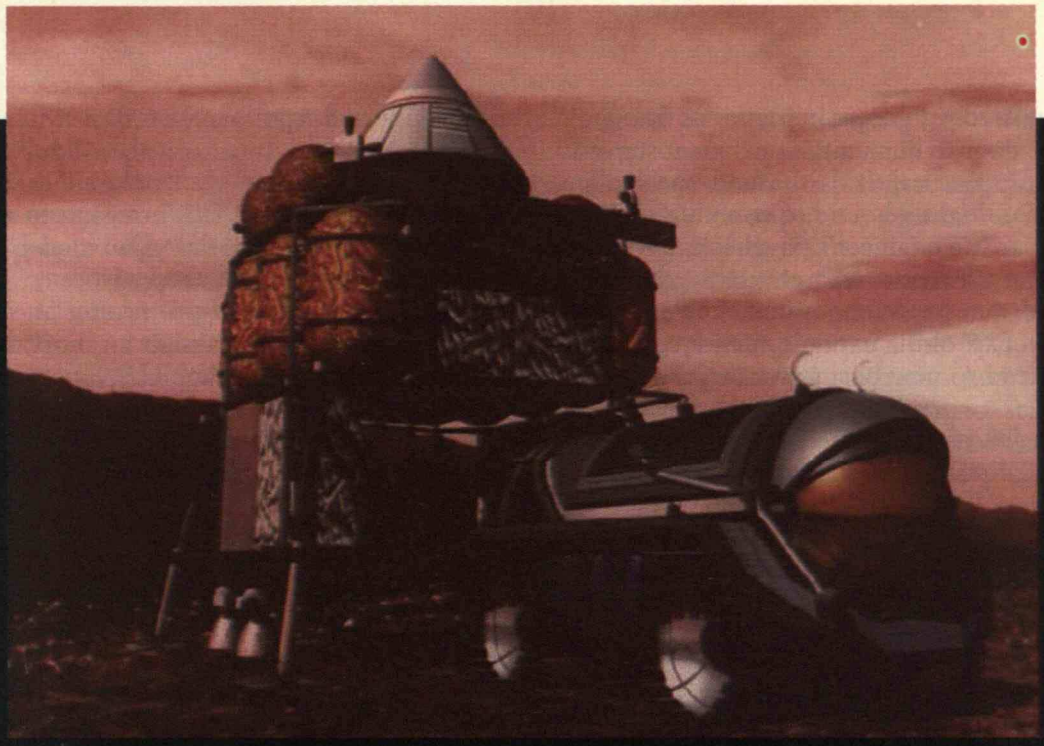
It is possible that someday millions of people will call Mars their home. Ultimately, we may even be able to devise techniques to alter the frigid, arid climate of Mars and return the planet to the warm, wet climate of its distant past. If a way were found to warm the polar caps, for example, enough carbon dioxide might be released into the atmosphere to warm the rest of the planet by means of the greenhouse effect. In so doing, we could transform Mars from a lifeless or nearly lifeless planet to a living, breathing world.

That is for the distant future. Yet we today have a chance to pioneer the way. All it takes is present-day technology mixed with some nineteenth-century chemical engineering, a dose of common sense, and a little bit of moxie.

Getting Down to Business

Now it's time to come back to earth. The greatest obstacle to gaining a foothold on Mars won't be found in the engineering details of a human Mars mission. It won't be found in the rigors of the journey or the long days exploring a new world. It won't be found on Mars. The greatest obstacle to sending humans to Mars resides here on our home planet in the guise of earthly politics. How can we raise the money needed to get the program off the ground?

President Bush's Space Exploration Initiative failed politically, but it was never seriously pushed. In actuality, there is plenty of latent political support in this country for a humans-to-Mars program. I have experienced this firsthand when speaking before numerous groups, from Rotary Clubs to plumbers' conventions—groups with no vested interest in a Mars program. The burning question is always, "How come we're not doing this?" In 1994, more than half of those queried in polls by *Newsweek* and CBS supported a piloted mission to Mars.



BOTH THE RETURN VEHICLE AND THE PRESSURIZED GROUND ROVER WOULD BE FUELED BY METHANE AND OXYGEN PRODUCED ON MARS. THIS STRATEGY WOULD LIGHTEN THE MISSION'S STARTING PAYLOAD CONSIDERABLY.

And an ABC News/*Washington Post* poll conducted in early 1996 found that a majority of Americans believed that the space program had brought enough benefits to the country to justify its costs. In fact, the main public complaint I hear about the space program is not that it costs too much but that it's not going anywhere.

Any serious call for a low-cost near-term human mission to Mars—namely, Mars Direct—would engender a growing juggernaut of public support. Of course, translating enthusiasm into funding is another thing entirely. But I see three principal models—each very different—for accomplishing this. I call them the JFK model, the Carl Sagan model, and the Newt Gingrich model.

The JFK model is the most widely understood because it's the only one that has been done—it's how we reached the moon. In this model, the president of the United States calls upon the nation to meet the challenge of the future. In his call for the Apollo program, JFK said it would create new technologies, new jobs, and new knowledge, but that going to the moon was fundamentally "an act of faith and vision, for we do not know what benefits await us." Kennedy's Apollo speeches rang with destiny. Few people hearing those speeches could fail to recognize they were witnessing history being made.

Kennedy's Apollo program set in place a paradigm, both political and technical, of how space programs should be launched. First and foremost, vigorous, clear, and visionary presidential support will lead any successful effort. These elements were all missing from Bush's initiative. Unlike Bush, Kennedy did not try to sneak his program through the political process or delegate it to a political lightweight. Instead, he stood in the well of the House of Representatives and announced his intentions to a special joint session of Congress. Second, Kennedy's was an American program, as befitted a major federal undertaking at the height of the Cold War. Last, there was money. Kennedy was forthright about the cost and, together with Lyndon Johnson, a political powerhouse in his own right, did what was required to fund it.

Can the JFK approach be taken again, this time to Mars? While the foreign policy imperatives of the Cold War are now just a memory, a successful American program of Mars exploration would still have enormous impact around the world. The first nation to set foot on

Mars will undoubtedly go down in history as the nation that opened the door to humanity's next great step into the future. In more practical terms, the funds spent taking us to Mars remain tightly bound to communities here on earth. They are an engineer's paycheck, a welder's take-home pay, a scientist's research funds, a graduate student's stipend; they pay for innovations and inventions that will remain part of the nation's intellectual capital and that may lead to new businesses or products for earthly use.

Although the JFK model succeeded once, the question may well be asked whether the nationalistic foundations that supported Apollo exist today. Instead of demonstrating American superiority, wouldn't it perhaps be better for a humans-to-Mars program to promote international cooperation? This brings us to an alternative approach, the one I call the Sagan model, after its most consistent, eloquent, and vocal advocate.

Carl Sagan has been promoting an international approach to Mars exploration for more than a decade. His original call focused on U.S.-Soviet collaboration, which he saw as a way to bind two adversarial nations together in a historic undertaking. The scientific talents of both nations would work toward ends other than

A Prize Progression

HERE'S THE SERIES OF PRIZES to drive the development of a humans-to-Mars program that I worked up for Rep. Newt Gingrich. Note that though these prizes can be viewed as a stepwise progression toward an ultimate goal, a single organization need not undertake all the challenges. A company could choose to accept one challenge and leave it at that, it could take the challenges on in succession, or it could skip the easier challenges entirely in an effort to get a crew to Mars first and win the grand prize.

CHALLENGE 1: To complete a Mars orbiter imaging mission. *The prize:* $500 million. *The conditions:* The mission must successfully image at least 10 percent of the planet with resolutions of 20 centimeters per pixel or better. (The best Viking pictures have a resolution of 10 meters per pixel. The planned Mars Global Surveyor should return images with 1.5 meter-per-pixel resolution.) All images must be made available to the U.S. government, which will publish them. *The bonus:* An additional $1 million for imaging (with 90 percent coverage or better) each of the 200 sites of interest selected by NASA's Mars Science Working Group.

CHALLENGE 2: To collect a sample of Martian soil with a robotic lander and transport the sample to earth using propellants of Martian origin for the return flight. *The prize:* $1 billion. *The conditions:* The soil sample size must be at least 3 kilograms. At least 70 percent (by weight) of the propellant mixture used on the Mars-ascent and earth-return legs of the mission must be produced on Mars from Martian resources. *The bonus:* $10 million for each distinct rock type returned, up to a maximum of $300 million.

CHALLENGE 3: To demonstrate a long-term life-support system in space. *The prize:* $1 billion. *The conditions:* A crew of three or more must be sustained in space for at least two years without resupply from earth.

CHALLENGE 4: To deliver a pressurized rover to Mars. *The prize:* $1 billion. *The conditions:* The vehicle must prove capable of sustaining two humans on Mars for one week by means of a one-week test conducted on earth during which it is driven 1,000 kilometers over unimproved terrain. The vehicle must travel at least 100 kilometers on Mars, with cabin pressure between 3 and 15 pounds per square inch and temperatures between 10 and 30 degrees centigrade.

CHALLENGE 5: To demonstrate the first system that uses propellants of Martian origin to lift a 5-tonne payload from the surface of Mars to Mars orbit. *The prize:* $1 billion. *The conditions:* At least 70 percent (by weight) of the propellant mixture must be produced on Mars from Martian resources.

CHALLENGE 6: To demonstrate the first system that can produce more than 20 tonnes of propellant on the Martian surface in the course of a 500-day stay. *The prize:* $1 billion. *The conditions:* At least 70 percent (by weight) of the propellant mixture must be produced on Mars from Martian resources.

CHALLENGE 7: To demonstrate the first system that can generate at least 15 kilowatts of power (day/night average) for 500 days on Mars. *The prize:* $1 billion. *The conditions:* A minimum of 2 kilowatts of electricity must be available at all times.

CHALLENGE 8: To demonstrate the first system that can deliver 10 tonnes of payload to the Martian surface. *The prize:* $2 billion. *The conditions:* The demonstrator must provide a soft landing exerting no more than 8-gravities deceleration (that is, a level tolerable to humans) on the payload during any part of the trip.

enlarging their nuclear stockpiles.

Today, nations that decided to collaborate on such a project would still enjoy an obvious economic benefit: more partners means more pockets. Technologies as well as costs can be shared. The United States, for example—having long since abandoned the trusty Saturn V rocket—lacks a launch vehicle with enough power to launch a Mars Direct–style initiative. But Russia has the Energia, the most powerful rocket on the planet, capable of lofting 100 tonnes to low earth orbit. Energia has flown just twice, in part because it has lacked a mission; a humans-to-Mars program would fit the bill nicely. The design of the international space station calls for using several Russian modules.

Of course, there are plenty of technical obstacles that can arise when undertaking an enormous collaborative effort: What if one of the partners signs on to develop a technology and then fails? What if a key partner drops out entirely? What if international relations change, and a friendly partner becomes a foe? Such events can completely destabilize the program schedule, and delays in projects as large as Apollo, the space station, or a Mars program tend to cascade, creating potentially disastrous consequences. To an extent, then, Sagan's proposal for a

CHALLENGE 9: To be the first to demonstrate a system that can lift at least 120 tonnes to low earth orbit. *The prize:* $2 billion. *The conditions:* The booster must launch from U.S. territory. A revived Saturn V system would be eligible.

CHALLENGE 10: To demonstrate the first system that can put 50 tonnes onto a trajectory toward Mars (no landing necessary). *The prize:* $3 billion. *The conditions:* Departure velocity from earth must be at least 4 kilometers per second. The system must be launched by a booster or boosters with a capacity of at least 120 tonnes to low earth orbit per launch. The booster must be launched from U.S. territory.

CHALLENGE 11: To demonstrate the first system that can deliver 30 tonnes of payload to the Martian surface. *The prize:* $5 billion. *The conditions:* The demonstrator must make a soft landing exerting no more than 8-gravities deceleration on the payload during any part of the trip.

CHALLENGE 12: To be the first to send a crew to Mars and return the crew members safely to earth. *The prize:* $20 billion. *The conditions:* A majority of the crew must be Americans. At least three crew members must reach the Martian surface and remain on the planet for at least 100 days. One or more crew members must make at least three overland trips of at least 50 kilometers from the landing site. *The bonus:* In addition to the $20 billion, crew members will receive $1 million per person for each day spent on the Martian surface, up to a maximum bonus of $5 billion.

Some general conditions would apply to all prizes, since some challenges encompass accomplishments covered by other tasks listed. For example, any system that can deliver 30 tonnes of payload to the Martian surface can also deliver 10 tonnes. If the more difficult mission is accomplished before the less difficult one, the organization performing the mission wins both prizes. To ensure that "home-grown" flight systems are developed, at least 51 percent of the cash value of the hardware would have to be manufactured in the United States. Finally, the winner of any prize would be required, at the government's option, to sell up to three additional copies of the winning flight system to the U.S. government, at a cost per copy no greater than 20 percent of the prize. The U.S. government, in turn, would provide all missions competing for the prizes with launch, communication, and tracking services at cost.

If a Mars Prize bill were passed, it would provide not only the needed incentives to get humans to Mars, but also a financial "runway" that would allow private organizations to accumulate the capital required to finance such a venture.

For example, an organization could start by focusing on winning prize 9, for developing the heavy-lift launcher. The $2 billion prize for this may not be much better than a break-even proposition, but once it is in hand, the organization would be in an excellent position to win prize 10—$3 billion for hurling 50 tonnes onto a trans-Mars trajectory. This second prize would set the organization up to win prize 11, $5 billion for the first soft landing of 30 tonnes on Mars. Once that was accomplished, the organization would have in hand the primary earth-to-Mars transportation system needed to fly the Mars Direct mission, as well as plenty of working capital, and could then launch an assault on the $20 billion grand prize for the round-trip human mission. Groups with smaller initial capital could start out by chasing some of the lesser prizes for precursor missions, and thus get into the game through the side door.—*Robert Zubrin*

joint venture may make the Mars program a hostage to stability in Russia or elsewhere. But on the other hand, the prestige and economic benefits that can accrue from participation in such a project may help preserve the very peace and stability on which the project would depend.

Eyes on the Prize

I call the third approach to getting humans to Mars the Gingrich approach because I devised it under the prodding of the speaker of the House. In the summer of 1994 I was invited to dine with Rep. Newt Gingrich (R-Ga.) and some of his staff to explain my ideas about Mars exploration. Gingrich was enthusiastic. "I want to support this with legislation," he told me, but he proposed doing it "in a more free-enterprise kind of way than just gearing up the NASA budget to go to Mars." He invited me to talk more about it on his TV show, which I did.

I then met several times with Jeff Eisenach, President of the Progress and Freedom Foundation, Gingrich's D.C. think-tank. What we came up with was the idea of a Mars Prize bill: the U.S. government would post a $20 billion reward for the first private organization to successfully land a crew on Mars and return it to earth, as well as several prizes of a few billion dollars each for attaining various technical milestones along the way.

This is, to say the least, a novel approach to human space exploration, which until now has been entirely government run. But it has a number of remarkable advantages. In the first place, this approach renders cost overruns impossible. The government will not spend a penny unless the desired results are achieved, nor spend a penny more than the award sum agreed upon at the start. Success or failure will depend solely upon the ingenuity of the American people and the workings of the free enterprise system, not upon political wrangling. After all, when Charles Lindbergh flew the Atlantic, he did it not as part of a government-funded program but in pursuit of a privately posted prize. Many such prizes were offered for breakthrough technical accomplishments in aviation's early years, and collectively they played a major role in raising the art of flight from its infancy to a globe-spanning transportation network.

There are other advantages as well. Because it would attract billions of dollars in private investment and technical development, the prize would spur economic growth even before any government expenditure. Moreover, this approach would call into being not only a private space race but a new kind of aerospace industry, one based on minimum-cost production. Under today's "cost plus" method, where the government pays aerospace companies 10 or 15 percent above whatever it costs them to do a job, contractors are overstaffed and have little incentive to control overhead. Under the prize system, the profit would be the value of the prize minus the company's costs, period. Firms would have a big incentive to drive costs down and would bear a much lighter accounting and documentation burden.

But how could the Mars Prize be set as low as $20 billion? Didn't I say that a Mars Direct program would probably cost the government $20 billion just to develop the hardware? Even if you threw in a series of secondary prizes ranging from $500 million to $5 billion for meeting lesser challenges, a private organization would hardly be tempted to venture $20 billion on a Mars shot.

THE HYPOTHETICAL ARES ROCKET THAT WOULD PROVIDE THE HEAVY-LIFT POWER NEEDED TO REACH MARS COULD BE DEVELOPED FROM SPACE SHUTTLE ENGINES FOR $1 BILLION

But my estimate of $20 billion for Mars Direct hardware is based upon the conventional approach, in which NASA funds major aerospace contractors to get the job done within their existing overhead structures, and spends a lot on itself for "program management." If Mars Direct were done on a truly private basis, with the people undertaking the effort being free to buy whatever they want from whomever they want, to build whatever they want, I believe that the cost of the effort would be in the $3–$6 billion range. It sounds incredible, but if you total up what is actually needed to fly the mission, it's hard to see why the program should cost more.

As a rule of thumb, aerospace systems that are comparable in sophistication to the Mars ascent vehicles, habitats, entry capsules, and other Mars Direct systems can be developed for about $10 million per tonne of dry hardware. The McDonnell Douglas DC-X single-stage-to-orbit test vehicle, for example, came in at $6 million per tonne. The total amount of hardware needed for Mars Direct, excluding launch vehicles, is certainly less than 100 tonnes. So budget $1 billion for that.

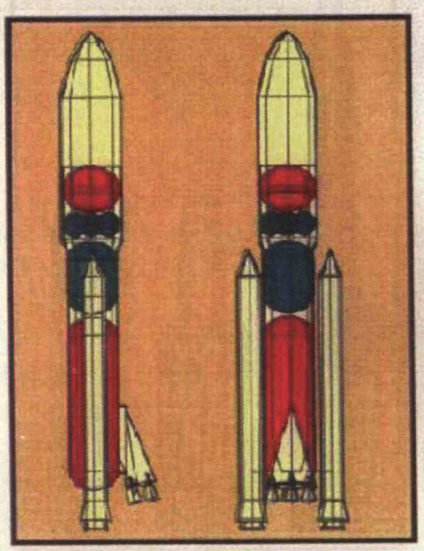
To launch everything you need for a mission to Mars, including propellant (which is cheap stuff, less than $1,000 per tonne), you would have to lift about 300 tonnes. That amount could be boosted to low earth orbit by three Russian Energias, which would cost about $300 million each, for a total of $900 million in launch costs, plus maybe $500 million in startup

expenses to revive the Energia production line. The total cost for all hardware development and launch would thus be $2.4 billion. Toss in another $600 million for mission operations, program management, legal costs, and other odds and ends, and you've got yourself a $3 billion Mars program.

If Energia or other Russian launch vehicles—such as Proton, which is in production and whose launch cost is about $4 million per tonne to low earth orbit—are not available (or not allowed under the terms of the prize), we'll have to build a new heavy-lift rocket. But even that doesn't have to add much to the cost of the mission. Existing medium-lift boosters can launch payloads for about $10 million per tonne. At that rate—which is extremely conservative since a heavy-lift launch vehicle such as our hypothetical Ares would enjoy major economies of scale—launching the required 300 tonnes would cost $3 billion. Such a booster could certainly be developed for $1 billion. Add that to the $1 billion for spacecraft hardware development and the $600 million in operational and other expenses, and you've still got a Mars program for less than $6 billion. So if the real cost of the mission is $3–$6 billion, a $20 billion prize ought to be able to mobilize the required capital from the private sector (*see "A Prize Progression" on pages 28–29*).

ARES LAUNCH VEHICLE

PAYLOAD CAPABILITIES (ALL WEIGHTS IN TONNES)	
TRANS-MARS (C_3 = 15 KM^2/SEC^2)	47.2
TRANS-LUNAR (5 DAY TRANSFER)	59.1
LEO (160 BY 160 NMI, 28.5 DEG)	121.2
LEO/NUS (160 BY 160 NMI, 28.5 DEG)	75.0
HEIGHT (M)	82.3
GROSS MASS (WITHOUT PAYLOAD)	2,194.6
STAGE-0	
TWO ADVANCED SOLID ROCKET BOOSTERS	1,214.5
STAGE-1	
EXTERNAL TANK (INCLUDING RESIDUALS)	35.8
SSME ENGINE POD (4 SSME'S)	28.6
USABLE PROPELLANT IN ET	723.5
TOTAL SSME THRUST (KN, 104%)	8,706
SPECIFIC IMPULSE (SEC)	453
STAGING RELATIVE VELOCITY (KM/S) (LEO TO MARS RANGE)	4.2 TO 5.5
STAGE-2 (IGNITED SUB-ORBITAL)	
USABLE PROPELLANT	158.8
INERT MASS	13.2
SINGLE ENGINE THRUST (KN)	1,113
SPECIFIC IMPULSE (SEC)	465
PAYLOAD FAIRING (ALS DESIGN)	20.4



No doubt many people would be skeptical that a piloted Mars mission could be flown for $6 billion—but that wouldn't matter. If the Mars Prize bill were passed, the only thing that would matter was whether a few investors think it could. We wouldn't have to convince a majority of Congress, only a Bill Gates. And if nobody took up the challenge, the whole exercise would have cost the taxpayers absolutely nothing.

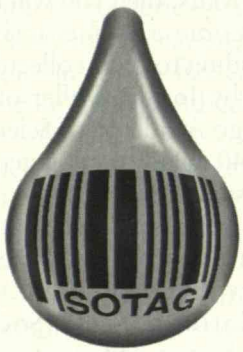
Still, getting the Mars Prize bill, or any other approach to Mars exploration, on the table is going to require vocal endorsement from the American people. If you want humans to get to Mars, then you will need to become a space activist. According to data collected in 1992 by Jon D. Miller of the Chicago Academy of Sciences, some 40 million adult voters are interested in space. Yet the two main domestic space activist organizations, the Planetary Society (Pasadena, Calif.) and the National Space Society (Washington, D.C.), comprise a total of perhaps 100,000 members, and a third group, The Space Frontier Foundation (Nyack, N.Y.), has only about 500 members. In other words, we have immense untapped, unorganized support for space exploration in this country. Permanent organizations with large memberships are the best way to generate the kind of political muscle required. So if you believe in a future that is not limited by earth's horizons, I urge you to join with other like-minded individuals and let your voice be heard.

Establishing the first human outpost on Mars would be the most significant act of our age. People everywhere today remember King Ferdinand and Queen Isabella of Spain only because they are associated with the voyage of Christopher Columbus. In contrast, few can name the predecessors and successors of these monarchs, and all the wars, atrocities, palace coups, scandals, booms, and bankruptcies that must have seemed so important to the people of that time are today nearly forgotten. Similarly, almost no one 500 years from now will know what Operation Desert Storm was, let alone the Whitewater scandal. But they will remember who first settled Mars. ■

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The Molecular Solution for Marking Explosives...

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The Olympics' Centennial Park. The World Trade Center. The Murrah Building. Harrods and Barclays. The Unabomber's 17-year trail of victims.

Images of devastating explosions are often accompanied by interviews with law enforcement officials explaining the complexity of tracking perpetrators and obtaining "beyond a reasonable doubt" evidence for convictions.

The fact that extraordinarily lethal explosives can be made with extremely ordinary materials has created an urgent – and unarguable – need for a foolproof, cost-efficient method of identifying the source and users of bomb components. Isotag has the only marker system that meets that challenge.

The Congressional Mandate

Under the Anti-Terrorism Act of 1996, Congress has mandated a study of the feasibility of tagging explosives and precursor products such as fertilizers, and is currently considering researching marking black powder as well. The message is clear – tagging for explosives will soon be required by law.

Isotags Outperform Traditional Tags

In the past, manufacturers and anti-gun control organizations fought standard plastic wafer and dye tagging systems because they reduced product efficiency, posed potential hazards, and significantly increased costs.

In the early 1990s, Los Alamos National Laboratory developed a new technology for "fingerprinting" products, the basis of Isotag's revolutionary molecular marking system. Today, Isotag scientists develop an exclusive tag by adding a hydrogen, carbon, oxygen, or nitrogen isotope to the basic molecule of the client's product. This host molecule exhibits the same chemical properties as the original, but is slightly heavier and completely unique, like a snowflake. These molecular tags can then be introduced at the parts-per-billion (ppb) level into any chemical or gas, and can be identified only with Isotag's highly-sensitive analytical systems. In effect, the Isotags "bar code" the product, for identification at any stage of the source, distributor, or user chain.

	Isotag Technology	Old Technology
Form:	Atoms and molecules	Plastic wafers or dyes
Size:	Molecule	Grain of sand
Amount Required:	50 ppb or 1 lb. per 10,000 tons	1 lb. per ton
Safety:	Same material as explosive; no interference	Foreign substance could affect safety
Efficiency:	No effect on explosive	Reduces charge due to volume
Survival:	Appears in any residue	Requires re-design of explosive
Exclusivity:	Infinite number of compounds	Limited number of combinations
Cost:	Inexpensive. Less than 10% of cost of wafers or dyes	Expensive

The Isotag Proof

Isotag recently completed research with a major manufacturer of ammonium nitrate, a key ingredient in the Oklahoma City bomb. The results clearly show that the isotopic tagging system works – the molecular markers were intact and easily identifiable after the explosion.

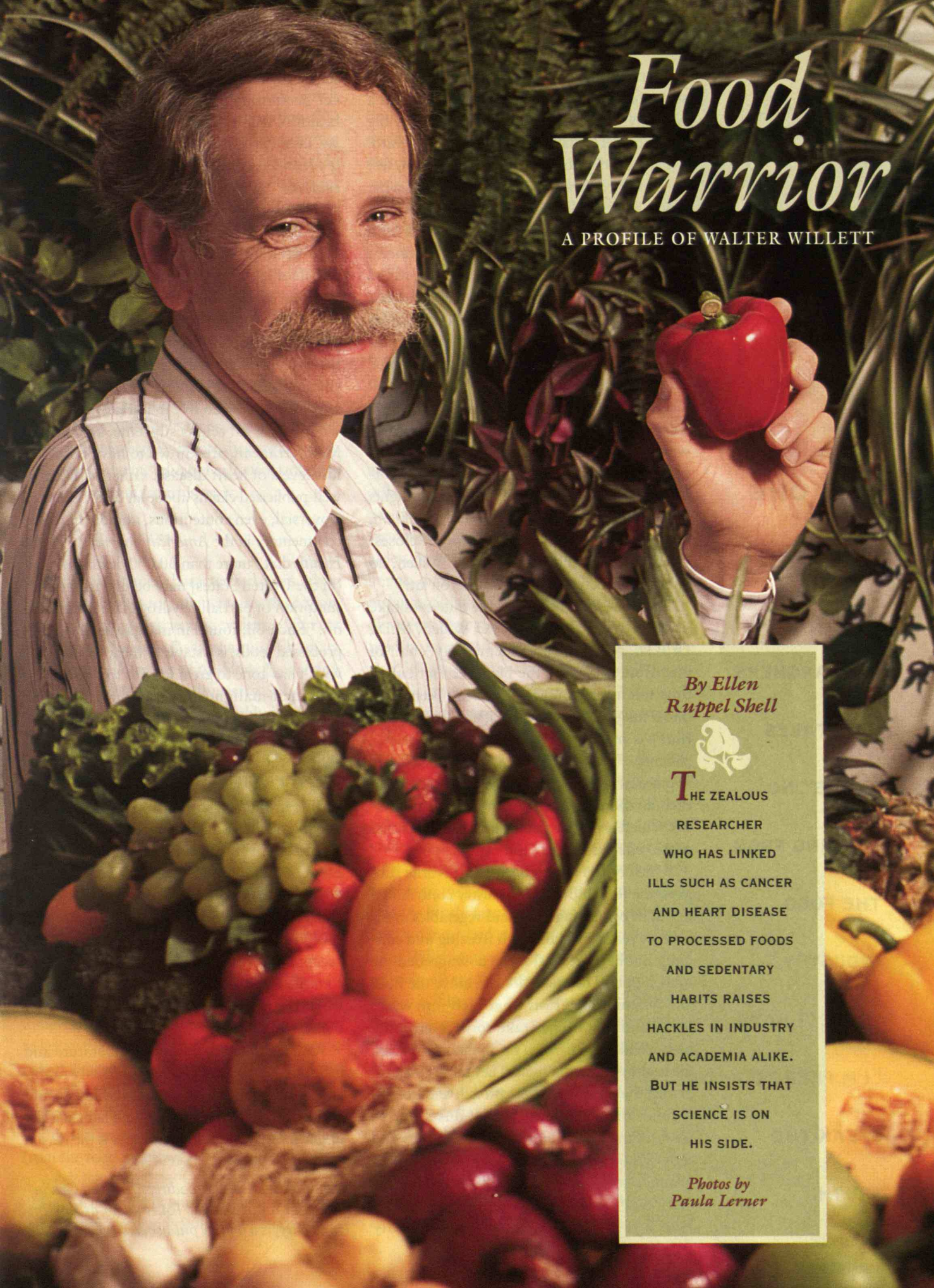
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Food Warrior

A PROFILE OF WALTER WILLETT

By Ellen Ruppel Shell

THE ZEALOUS RESEARCHER WHO HAS LINKED ILLS SUCH AS CANCER AND HEART DISEASE TO PROCESSED FOODS AND SEDENTARY HABITS RAISES HACKLES IN INDUSTRY AND ACADEMIA ALIKE. BUT HE INSISTS THAT SCIENCE IS ON HIS SIDE.

Photos by Paula Lerner

I'M ONE OF THE FEW FOOD RESEARCHERS WHO TAKES ALMOST NO FUNDING FROM THE FOOD INDUSTRY," WILLETT SAYS. "I'M FREE TO SPEAK THE TRUTH."

WALTER Willett stands in greeting, his courtly smile making you back up and wonder what a nice guy like this is doing behind a really big desk at the Harvard School of Public Health. You notice that the desk in question is two feet deep in documents, assorted books, and what might be yesterday's lunch. The windows are greasy, which is just as well, since there's no view to speak of. A mud-spattered mountain bicycle cocks against one wall. Stepping round the mess to shake hands, you see that Willett has neglected to remove the bicycle clips from his khakis. A pair of 49-cent plastic pens stand s guard in the pocket of his never-pressed blue Oxford shirt. His high forehead, bristling mustache, and haystack of salt-and-pepper hair are somehow suggestive of Henry David Thoreau, which sets you musing over how great it would be for the two of you to skip out of this overheated office and swap transcendental insights at Walden Pond. You shrug off the daydream, toss a couple of manuscripts from the closest chair, sit down, and blurt out: "Dr. Willett, do you really believe that pasta makes you fat?"

The smile loses its crease, the blue eyes take on a steely gaze, and Walter C. Willett, M.D., Dr.P.H., professor of epidemiology, chair of nutrition, folds into the black leather couch three feet from your face. "Pasta has been made into a magical food because it's low in fat, but that's a myth," he begins with practiced patience. "Very lean people working long hours at physical labor can tolerate large quantities of carbohydrates. But most Americans cannot." To Willett's way of thinking, pasta, like most processed foods, is just short of junk.

Which brings him to one of his favorite subjects: the food industry. "Industry contributed to health by making fruits and vegetables available all year round through freezing and canning. But beyond that, it has downgraded the food supply. They take flour, remove the fiber and vitamins, and turn what's left into white bread and pasta. They take corn, remove the high-fructose corn syrup for humans, and feed the healthy part to animals. They take soybeans, extract the oil, and feed the protein and fiber to animals. In general, the food industry strips foods of micronutrients and concentrates and refines the carbohydrates, sugars, and fats to produce something more expensive and less nutritious."

As a result, Americans eat a decidedly unhealthy diet, heavy on artery-clogging, cancer-promoting processed foods and light on healthful whole grains, fruits, vegetables, and, yes, even fats. "Fat has become a whipping boy. It's been identified as a villain without scientific evidence," Willett scoffs. "But there is good fat and there is bad fat."

Willett made famous the idea that monounsaturated fat—the kind found in olive oil, canola oil, and fish, among other foods—is healthful because it increases the ratio of beneficial high-density lipoproteins to harmful low-density lipoproteins in the blood. This boost to the fish and olive industry went down fairly smoothly in part because it made common sense—people who live in parts of the world where olive oil reigns supreme, such as the Mediterranean, are known to have relatively low levels of heart disease. Other of Willett's well-publicized claims about fat have been controversial, even contentious, notably his 1994 commentary in the *American Journal of Public Health* that "more than 30,000 deaths per year [in the United States] may be due to the consumption of partially hydrogenated vegetable oil." Such oil, found in margarine and other processed foods, is a staple of the food industry, which has gone to great lengths to substitute it for much-maligned saturated fats in many products.

But Willett has no soft spot for saturated fat, either, or for the dairy and meat products that carry it. Asked a few years ago what amount of red meat humans should consume, Willett's unequivocal response—"zero"—prompted a surprise visit from the National Cattlemen's Association, whose representatives moseyed down the corridors of Harvard in their boots and string ties hoping for a gander at his data. Willett was polite but firm: not a peek. "We accept requests from outside investigators to come here and look at our data," he says. "But we turn down requests when the goals are not central to our mission."

Willett's data are the key to his stature and influence. Drawn from scrupulously maintained long-term investigations of lifestyle and health, they generate both heat and light at a clip of one journal article a week. Data is the reason

ELLEN RUPPEL SHELL, codirector of the Graduate Program in Science Journalism at Boston University, is a widely published science writer.

why Willett wisdom is front-page material, the talk of the talk shows, and why a quick search of one online news database lists more than 500 references to his name. Perhaps the best-known findings emanate from the Nurses Health Study (NHS), a 20-year investigation of diet and health involving 121,700 women. NHS has linked hydrogenated vegetable oil, red meat, hormone replacement therapy, birth control pills, and alcohol to various cancers. It has targeted obesity as a factor in heart disease, gallstones, diabetes, and shortened life. And it has found associations between exercise and a lowered risk of diabetes; vitamin E and a reduced incidence of heart disease; and vegetable consumption and fewer cases of breast cancer and birth defects. But Willett's proclivity for going public with his theories before they are carved in scientific stone has elicited criticism not only from industry but from his peers.

Sounding the Alarm

Willett is sometimes characterized as an advocate whose rushes to judgment are based more on ideology than on scientific evidence. "I'm not one of his admirers," says Samuel Shapiro, physician and director of the Slone Epidemiology Unit at Boston University School of Medicine. "He is certainly a highly intelligent person, but he gets carried away with his data. He's made many statements that simply can't be defended scientifically." John Erdman, an experimental nutritionist and director of nutrition sciences at the University of Illinois, agrees. "I'm an old colleague of Walter's, we've sat on committees together, worked together, and I have a lot of respect for him. But where many people differ with him is when he takes evidence that is just suggestive and uses it to show cause and effect."

Willett and his comrades-in-research at Harvard respond to such criticism with respectful disagreement. The public, they argue, deserves to know that certain behaviors may increase the risk of ill health, and they need to know as soon as possible. If Harvard doesn't sound the alarm, who will? "I'm one of only a handful of people in this business who takes almost no funding from the food industry," Willett says. "I'm free to speak the truth."

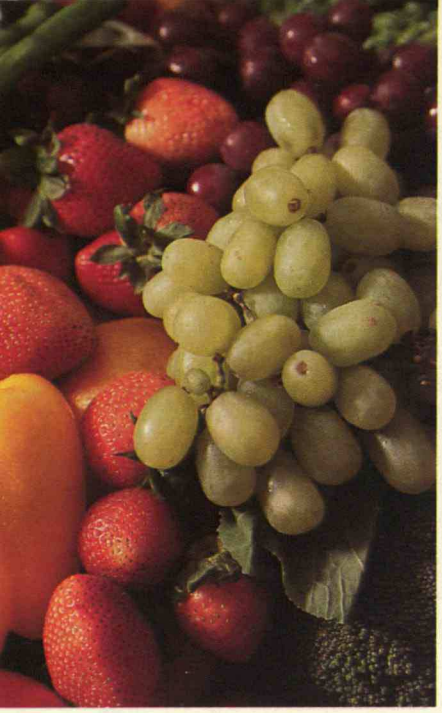
Gary Curhan, a nephrologist and epidemiologist, has worked with Willett on a study of calcium intake and kidney disease. "People think he's controversial because they don't have his data," he says. "But he never jumps to conclusions. He's extremely cautious—it took me a year and a half to get him to sign off on one piece of work we did together. Willett's goal is not to prove anyone right or wrong, but to do good science."



Willett's business, nutritional epidemiology, is a relatively young specialty that itself is riddled with controversy. Nutritional epidemiologists ferret out links between diet and health—the connection between, say, cholesterol-rich foods and heart disease, or salt and high blood pressure, or fat and cancer. The difficulty with this approach is that its practitioners must observe and record the behavior not of cells in petri dishes, or animals in cages, but of people living free-floating lives. There are a seemingly unlimited number of extraneous variables, or "confounders," that might have an impact on the health outcome under study. For instance, although Willett and other epidemiologists have found a modest association between breast cancer and moderate alcohol consumption, it's possible that both alcohol and breast cancer correlate with a third variable, say exposure to microwaves, that has gone unmeasured.

While acknowledging this, Willett is quick to defend his approach. Epidemiologists, he says, recognize that a single study proves nothing and at best may suggest a relationship among variables. For that very reason they rely on an accumulation of data from multiple studies to build a case. When many studies point in the same direction, they may safely propose an association. As for the specific matter of his findings on breast cancer and moderate alcohol consumption, Willett points out that his was only one of roughly 40 studies that came to the same conclusion. There is, he continues, a plausible mechanism for the effect: alcohol raises the level of estrogen in the body, and estrogen levels are strongly associated with breast cancer.

But Boston University's Shapiro, who has publicly debated Willett in more than one forum, vehemently disagrees. "Walter says there are 40 studies, and there might be, but they could well all contain the same biases," he argues. "We know, for example, that breast cancer is more common in women of higher



socioeconomic status than in other women. There could be a correlation between high socioeconomic status and drinking; therefore, affluence, not drinking, might be heightening the breast cancer risk in moderate drinkers. My point is that when you are looking at a relative risk of less than twofold, it is beyond the resolution of the epidemiological microscope. Nutritional epidemiology is vitally important, but the problem is that no one knows how to do it well. All nutrients are so highly correlated with one another that it's next to impossible to single one out as good or bad."

Willett bristles at such talk. Nutritional epidemiologists, he says, were the first to associate consumption of animal products with coronary heart disease, a link that is now all but taken for granted. They have also found indisputable associations between cancer and diet, associations that have held up across ethnic groups and across continents.

"What nutritional epidemiologists try to do is provide information so that people can make the most informed decisions, not make those decisions for them," he explains. "Scientific evidence clearly supports a diet-health connection." That said, he waxes prescriptive once again: "What's perhaps even more important than harmful influences is the lack of protective foods. There's no question that fruits and vegetables are protective, and that most of us eat far too few of them."

The Power of the Questionnaire

Willett's love affair with produce stretches back to his childhood in rural Michigan, where he rose in the ranks of the 4-H Club to become an award-winning judge for the National Vegetable Growers Association. He studied physics at Michigan State but switched to food science after deciding against what he determined would be a "life doing experiments in dark basements." He went on to take a medical degree, and to do his internship and residency in internal medicine at the University of Michigan.

"It was incredibly frustrating," he recalls. "I kept seeing the same patients again and again, and almost no one was cured. I had the feeling that the majority of these people had conditions that could be prevented. These were diseases of excessive food consumption and inactivity—diabetes, hypertension, heart disease—yet no one was telling people that they could do something about their health problems, that they could change their lifestyle, that they could take control. Part of this was related to our lack of knowledge at the time, and part was due to a lack of expectation that people would actually take steps to make their lives healthier."

One step Willett took to make his own life healthier was to avoid military service in Vietnam, opting instead for conscientious-objector service in an East Boston health center. Since he worked nights, his days were free to pursue a master's degree at the Harvard School of Public Health. This he used to secure his first academic appointment—in the departments of Internal Medicine and Community Health at the University of Dar es Salaam in Tanzania.

"By then I realized that prevention was the way to go in public health," he says. Africa had plenty of ill health to prevent, notably the nutritional deficiencies brought on by roundworm infestation, which became a focus of his work during his four-year stint. Struggling to control such threats, he acquired an appreciation for the power of that most fundamental of epidemiological tools, the questionnaire. "I was struck by the amount you could learn simply by asking questions," Willett says. He learned, among other things, that "income was a strong determinant of diet in Africa—very small differences in income translated into very large differences in diet. The higher the income, the more animal protein and fat in the diet. And differences in diet correlated with differences in health."

Willett returned to Boston in 1971 and became a research fellow in medicine at Harvard Medical School and Peter Bent Brigham Hospital, where he honed the crude data-collection skills he had mastered in Africa. In 1980 he found what was to become his permanent home—the Nurses Health Study.

Launched in 1976 by Frank Speizer of Harvard Medical School, the Nurses Health Study was not the first long-term epidemiological effort to tie behavior to health—the Framingham Heart Study, begun nearly three decades earlier, held that distinction. But the Framingham approach involved expensive in-person interviews and physical examinations, and was by definition limited in scope. Speizer was inter-

ested in the really big picture. He had worked with Oxford University's Sir Richard Doll, the legendary epidemiologist who had nailed down the connection between lung cancer and smoking in the early 1950s by tabulating responses to a questionnaire he'd sent to 60,000 male doctors in Britain. Speizer wanted to do the same with women in the United States, but since there weren't many female physicians to study at the time, he sent his questionnaire to a few thousand doctors' wives. No go: for whatever reason, they didn't respond. So Speizer tried nurses. The rest is history: not only did Speizer find the association he was looking for between lung cancer and smoking in women, but his work caught the attention of Willett, who eventually joined the study and used the same pool of subjects to pursue his own wide-ranging research on lifestyle and health.

What gives the Nurses Health Study its power is that, like the Framingham study and the one by Doll, it is prospective rather than retrospective. While retrospective studies attempt to correlate outcomes with what participants recall about their past behaviors, prospective studies measure both behaviors and outcomes as they unfold. A retrospective study of smoking and cancer asks cancer victims about their past smoking habits. This is a shaky business at best because so many people either lack or repress memories of unhealthy behaviors. Prospective studies, on the other hand, allow researchers to question subjects on their current habits, and then wait for a period of years to see which people develop disease.

"Richard Doll showed how the use of large prospective studies to investigate causes of disease could have a huge payoff," Willett says. "He also showed that they required a long-term commitment." Willett mined the Nurses Health Study for four years, extracting data for his doctoral thesis on the link between smoking and coronary heart disease. He then decided to build upon Doll's and Speizer's methods to develop a truly comprehensive instrument to study lifestyle and health, one that would consider a wide variety of variables: "It occurred to me that the Nurses Health Study was an ideal setting in which to collect dietary data from a very large population that was already being followed. So I started developing dietary assessment methods."

Willett's original two-page dietary questionnaire has since ballooned into a six-page, single-spaced drill sheet—the sort of terrifying document that requires a high level of fine motor skill and a pile of number-two pencils. The questionnaire probes into such touchy matters as waist and hip measurements and lingers over such rarefied concerns as how often pan-fried versus broiled chicken is eaten, and whether said poultry's appearance is lightly browned, medium browned, well browned, or charred. Next come questions of gravy texture. Amazingly, 90 percent of the nurses in the study dutifully fill out and return the forms every two years, occasionally bundling along "body parts" such as blood or urine samples and even toe-nail clippings. The study has proven so fruitful that a decade ago Willett and his colleagues launched Nurses Health Study II, geared toward younger nurses, and another somewhat smaller study of male health professionals.

A Torturous Process

Together the studies generate what seems to be enough data to keep a supercomputer crunching for weeks on end. Unfortunately, there is no supercomputer. Happily, there is Gary Chase and his bevy of faithful data processors.

Project coordinator Chase manages the torrent of incoming and outgoing questionnaires from a suite of dingy, airless offices deep in the bowels of Boston's congested medical district. His is a Sisyphean task, for by the time one wave of questionnaires is logged and coded, the next wave comes crashing through the door. "Basically, I run a junk-mail operation for science," he deadpans, flapping a weary arm toward a teetering tower of outgoing envelopes. "It's sort of like a grassroots political campaign, without the politics."

Chase employs two full-time staff members just to deal with changes of address and another to track down subjects' medical records and death certificates. "Remember, this study has gone on for almost 20 years. People's lives change, they move, they retire to Florida. They don't always tell us where they're going. There is an awful lot of detective work involved. And sometimes we lose them altogether. One nurse quit the study because she didn't like Harvard law professor Alan Dershowitz. Didn't want anything more to do with Harvard—any part of Harvard, including our letterhead."

WILLETT NOTES THAT AS THE VARIETY OF LOW-FAT, NO-FAT, AND CALORIE-REDUCED FOODS HAS GROWN, SO HAS OUR NATION'S COLLECTIVE WAISTLINE.

WILLETT HAS DECLARED ALL-OUT WAR ON THE FOOD INDUSTRY ON AT LEAST ONE FRONT: OLESTRA. PROCTER AND GAMBLE'S NEW FAT SUBSTITUTE, HE SAYS, "ABSORBS FAT-SOLUBLE NUTRIENTS LIKE A SPONGE."

Designing the questionnaires, which are updated every two years, is itself a torturous process, involving a biweekly roundtable of as many as two dozen researchers, each of whom believes his or her question is critical to public health. The space for questions is limited, and the process of narrowing down the finalists mind-numbingly detailed, at least as observed at one session. On the table were matters not only of scientific relevance but of linguistics and even philosophy.

The three-hour meeting began with a discussion of the study's upcoming twentieth-anniversary party, planned for the following winter, but quickly homed in on a heated debate over how best to define "rigorous" exercise. Several researchers pointed out that sweat was not a reliable marker because many nurses get their exercise in a swimming pool, where sweat is beside the point. The participants decided that sweat was not an adequate measure of strenuous. From there it was but a small hop to the burning question of what one researcher meant by the phrase "dubious menopause." A brief exposure to this kind of discussion is enough to yield a deep understanding of why studies like Willett's are so rare. But the fruit of these talmudic labors, the questionnaire itself, is considered by many to be the Stradivarius of epidemiological instruments.

"This is the crème de la crème of nutritional epidemiology," says Elena Martinez, a postdoctoral fellow who came to Harvard with degrees in epidemiology and nutrition from the University of Texas School of Public Health. "Other studies are smaller, and the nutrition data are secondary. Here, one of the main things studied is diet, and the data are huge."

Huge, yes, but are they valid? Rumor has it that some of the nurses fill out the forms on the fly, simply guessing as to how many stairs they climb and how much booze they consume in a given week. Willett contends that the questionnaire has been thoroughly validated in a subgroup of nurses who were asked to keep a 28-day food-frequency diary. The diary closely matched their memory, which, Willett says, proves the questionnaire's accuracy. Critics, however, are unconvinced.

"Walter claims to have validated his food-frequency questionnaire with a diary, but if you asked me to keep a diary you'd be in big trouble," Samuel Shapiro says. "I'm too absent-minded to take life-saving medication, let alone write down everything I eat. People are highly selective about what they record in terms of diet. Also, the Nurses Health Study is simply not representative of the general population. It is a small subset of highly motivated, health-conscious individuals."

This last point garners general agreement. There is no question that the study's subjects—affluent, educated, mostly white health professionals—are not representative of all women. "It's very difficult to find a population with a response rate of 90 percent. I can't think of any other population that would be equally motivated to participate," says Elena Martinez. "But we cannot generalize beyond the population we're studying. For instance, in Mexico there is a big problem with obesity, but not with heart disease or colon cancer. There may be some genetic differences. Our studies have internal validity, but if we extrapolate to other populations we run into limitations."

But Willett maintains that studies of homogenous populations are not only convenient but preferable. As far as he is concerned, diversity for its own sake only confuses the matter: "It's best to study a homogeneous population. That's why our studies are so strong. There's not much poverty, everyone has about the same education, so there is less room for confounding. The political line of the moment is to include everyone, to get diversity." Yet it's worth remembering, he notes, that diversity per se is not desirable in animal studies, where politics is not an issue. "When you are studying a population of rats, you don't just collect rats off the street—you want to control for some factors."

Playing the Crusader

Willet does not deny his role of crusader; indeed, he relishes it. His battle against the cholesterol-boosting "trans-fatty acids" in partially hydrogenated oils rages on—he has demanded that manufacturers label foods to let consumers know just what they're getting into when they dive into that tub of supposedly healthful no-cholesterol margarine. He remains loudly critical of low-fat and no-fat products as well, warning parents that both nutritional deficits and galloping weight gains may be in store if they let their kids wile away Saturday mornings in front of the tube with a

box of fat-free cookies on their laps. "There's been an enormous amount of research devoted to exploiting our natural fondness for sweet taste," he says. "We evolved a preference for sweets—perhaps, as one of my colleagues suggests, to ferret out sweet, young plants that provide usable carbohydrates. But in this sedentary society with its almost limitless supply of food, we have to fight our evolutionary instincts."

And his skirmish with the food industry has grown into an all-out war on at least one front: Procter and Gamble's olestra, the fat substitute approved by the Food and Drug Administration last January and now undergoing test marketing in three midwestern cities. Olestra, unlike other fat substitutes, doesn't break down when exposed to high temperatures, making it suitable for frying chicken, french fries, tortilla chips, and other munchies. Hence people could eat a good deal of it, particularly the more than half of Americans who worry about their weight.

"Olestra absorbs fat-soluble nutrients like a sponge," Willett says. "We're talking not only vitamins but carotenoids, fat-soluble micronutrients found in fruits and vegetables with importance to long-term health. There's a huge literature showing that low levels of carotenoids in the blood are associated with cancer, heart disease, and stroke."

As usual, Willett is casting himself as David to the food industry's Goliath. Procter and Gamble's petition to the FDA included 270 volumes with more than 150,000 pages of data, the great bulk of it in olestra's favor. And while strongly suspected, the health value of carotenoids, the pigments that make squash yellow and spinach green, has yet to be established conclusively. Most importantly, many nutrition scientists contend that the weight-reducing potential of a widely used fat substitute is critical in a country where obesity is an omnipresent threat.

"We really don't know much about carotenoids. Their use is still to be determined," says John Erdman of the University of Illinois. "But I strongly believe that the major factor leading to bad health in this country, after smoking, is obesity—it's a major factor in heart disease, cancer, bone problems, diabetes—and anything we can do to control it is worth trying, even experimenting with olestra. Maybe Walt's friends are all highly educated people who will modify their diets and exercise for a healthy life, but it's not working for most of us."



Willett has little patience with these arguments. "The burden of proof has to be on the safety side," he says. "If you are uncertain about the safety of a product, you don't test it by feeding it to a whole population, including pregnant women and children." Nor is he convinced that olestra is going to help anyone lose weight: he notes that as the variety of low-fat, no-fat, and calorie-reduced foods has grown, so has our nation's collective waistline. The bottom line is that the food industry responsible for olestra exists not to improve anyone's health but to make money.

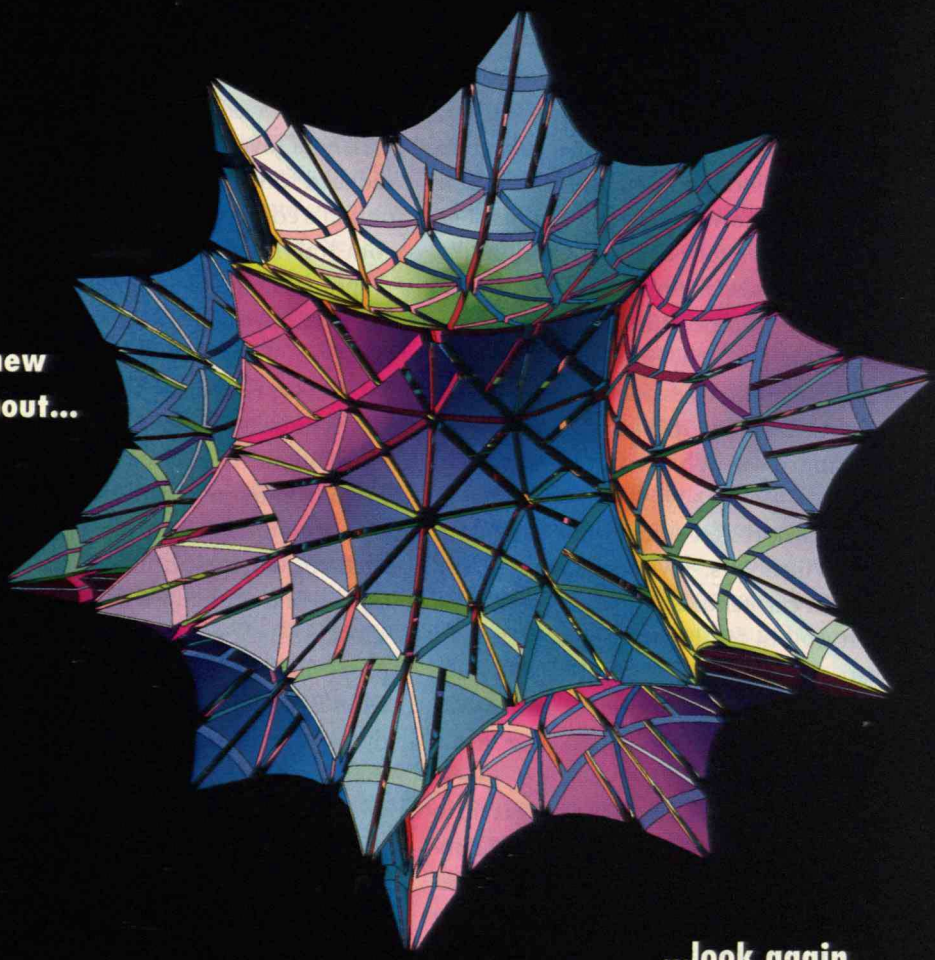
"Obesity is a big problem in this country, but so far, industry's been part of the problem, not the solution." he says. "They put fat and refined carbohydrates into convenient, attractive packages, then market them like crazy, to us, to our children, and, in particular, to the poor. In many aspects of nutrition, we basically transfer problems down the socioeconomic scale. Educated people in higher income groups know that butterfat is not good for them, but once you've got the milk from the cow, you've got to do something with the fat. We can't run our cars on it, so what do we do? We put it in school lunches and give it away to poor people on food subsidies."

The wealthy, by contrast, know what to do to maintain good health, and it works, he says. "Educated men stopped smoking, watched their weight and what they ate, and their age-adjusted mortality went down dramatically. This is a demonstration that there is great potential for improvement. We can all take control of our health. Sooner or later that message is going to trickle down to everyone."

Leaving the Harvard School of Public Health, you can catch sight of the cafeteria, where a plate of cookies the size of hockey pucks sits cheek by jowl with a display of deep-fried snacks. Certainly, Willett's task is a thankless one. But he has made at least one convert. Floating past the den of temptations on a cloud of messianic inspiration, you head to your car secure in the knowledge that you can make it to the produce store before dinner time. Vegetables, you've decided, are the answer.

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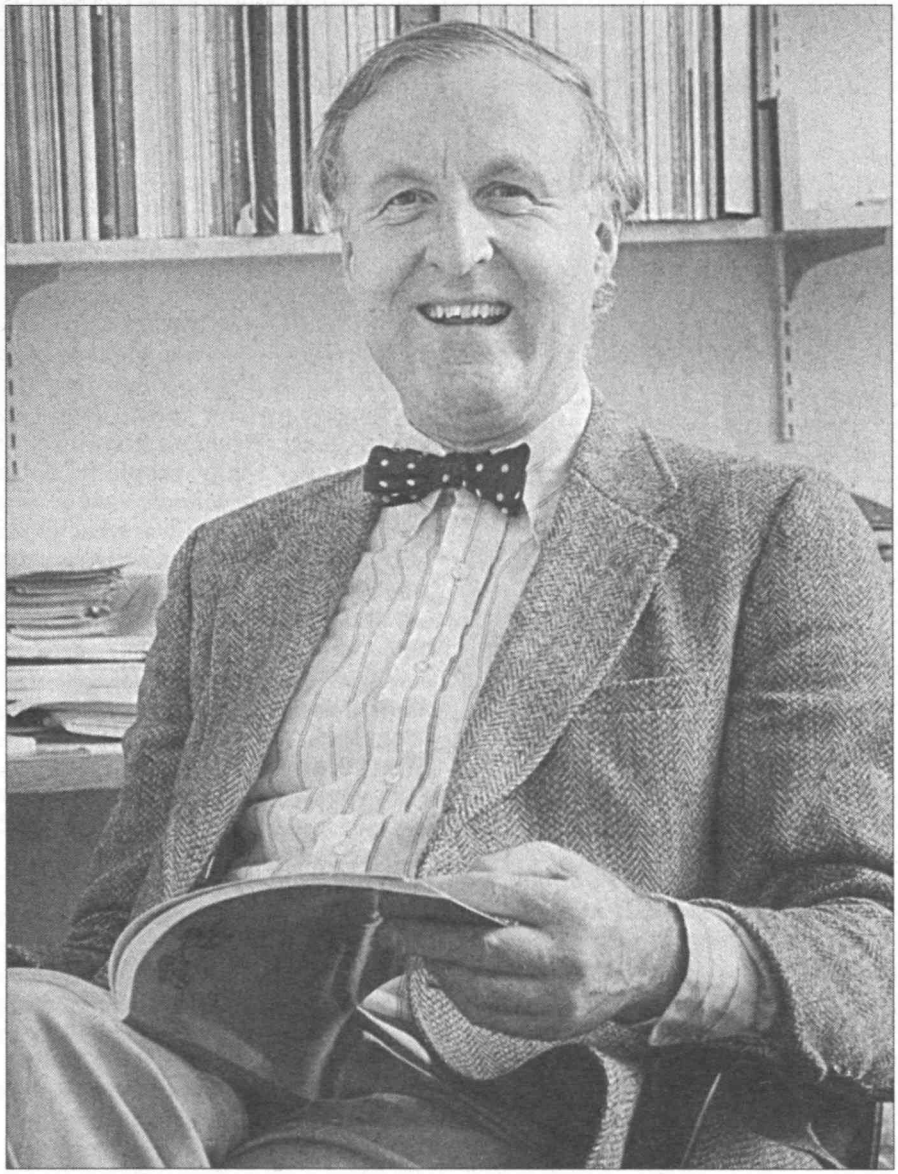
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MITnews

FROM THE ASSOCIATION OF ALUMNI AND ALUMNAE OF MIT NOV/DEC 1996

PROFILE

Robert Weatherall's Careers-Building Career



"I happen to be a contrarian among careers people," says Robert K. Weatherall, who retired early last summer as director of MIT's Office of Career Services and Preprofessional Advising. That's putting it mildly. Weatherall has attacked *What Color Is Your Parachute?*, the bible of the career-counseling profession, as largely irrelevant to successful job searching. He generally dismisses personality and aptitude assessments, workshops on resume writing, and seminars on networking—all staples of the typical careers office—as time wasters. And he finds the idea that career advisers should have degrees in counseling, as recommended by their professional association, to be "seriously mistaken." He headed the MIT office for some 27 years, so his opinions have weight.

Lots of contrarians are also curmudgeons. But make the rounds of Weatherall's associates, professional contacts, and former advisees, and you will find only the warmest praise for his grace, enthusiasm, and erudition concerning the intersection of technology and commerce. "He's the incarnation of the traditional gentleman," says Till Guldimann, currently executive vice-president of Infinity Financial Technology and former head of research at the investment bank J.P. Morgan, a leading recruiter of MIT graduates. "But Bob combines that old-world charm with real understanding of high-tech business," Guldiman says.

Weatherall believes that the career adviser's job is to focus not on what's happening inside the heads of graduating students but on what's happening outside the university. Over the past 30 years, he's made himself an expert on

PHOTO: TED FITZGERALD

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The Millenial Class is Here

The new millenium got underway—admissions-wise, anyway—this fall, when the Class of 2000 arrived on campuses across the nation. At MIT, that meant 1,080 eager 18-year-olds, chosen from a record 8,022 applicants. They are smart: 83 percent ranked in the top five percent of their high school class. They are diverse: 42 percent are female; 45 percent are minority students; and 8 percent are international students. And they may be some of the most fortunate people on the planet because, as President Vest reminded them, they "will be entering the new millenium with all the tools of an MIT education." —SUSAN LEWIS



Get networked: Use the Internet to update the MIT Alumni/ae Association's information about your address, e-mail, or work by writing to: <mitalum@mitvmc.mit.edu>. To check the Association Web page, go to <http://web.mit.edu/alum/www/>.

Weatherall

continued

the subjects of how investment banks use computers and advanced mathematics, how management-consulting firms approach systems analysis, how silicon-wafer manufacturers use robotics. As a result, when seniors or graduate students come into his office looking to leave academia, Weatherall can steer them to job options that they may never have heard of. Weatherall finds that the students who come to him don't need much in the way of "values clarification" or aptitude testing: "I think MIT is one enormous vocational-interest test," he says. What they often lack is a sense of the ways in which their training and skills may be valuable to nontraditional employers.

Weatherall's fascination with what makes technologists tick and how their skills are applied in the real world—and his longevity—have earned him high marks from recruiters, according to Guldimann: "Many people in Bob's position at other schools view it as a temporary job, but this was what his life was about and his long-term experience was very valuable. Bob was an early adopter of the idea that MIT students had potential on Wall Street; he arranged fascinating seminars that allowed us to explain the larger picture to students, who were resistant at first. And he had a high appreciation of Morgan's needs, so he was very good at picking out the right students for us." According to David Verrill, until recently the associate director of corporate development at MIT, "Bob has done an exceptional job at helping new companies come onto the campus to recruit successfully. He's incredibly dynamic—he seems to be everywhere at once."

Such acumen on Weatherall's part has helped MIT graduates ride the shifting currents of technology related employment better than most. When he took the job in 1969, most graduates leaving academia were scooped up by the major defense contractors and manufacturing companies. In fact, nearly 50 percent of the employers recruiting on campus were either Defense or Energy Department contractors, federally funded labs, or companies in the oil, chemicals, materials, or food industries. Today, these employers make up only 10 percent of recruiters. Their place has been taken by software firms (19 percent), computer-related and communications companies (16 percent), and financial institutions (10 percent), which together made up only 10 percent of recruiters in 1969.

Another major difference is that today, most recruiters on campus employ 200 or fewer people and so have broader expectations of their engineers or scientists: No longer confined to the lab, employees of small companies must be ready to deal directly with customers, shop-floor workers, and executives—and even become executives themselves. Weatherall prepared students for this new world by bringing back alums to talk about the challenges and rewards of their careers (as well as to recruit). He also spent long hours with each student who came to him in one-on-one discussions aimed at exploring how the student's career ambitions correlated with specific job functions, specific companies, specific industries, and the culture of business in general.

"I'm a scientist manqué," says Weatherall. Although his own academic interests led him to read history at Cambridge University in his native England, he has been seriously interested in science since childhood. His father was a science master at Eton College, which Weatherall attended, and as a boy Weatherall spent much of his time reading about quantum theory and other scientific topics in books for lay readers. At Cambridge, he heard astronomer Sir Fred Hoyle and physicist Werner Heisenberg lecture. "That kind of thing has always turned me on," he says. "So this job has been wonderful because I've been able to be a dilettante about the physics profession, the mathematics profession, Wall Street, and management consulting, and it's all grist for the mill."

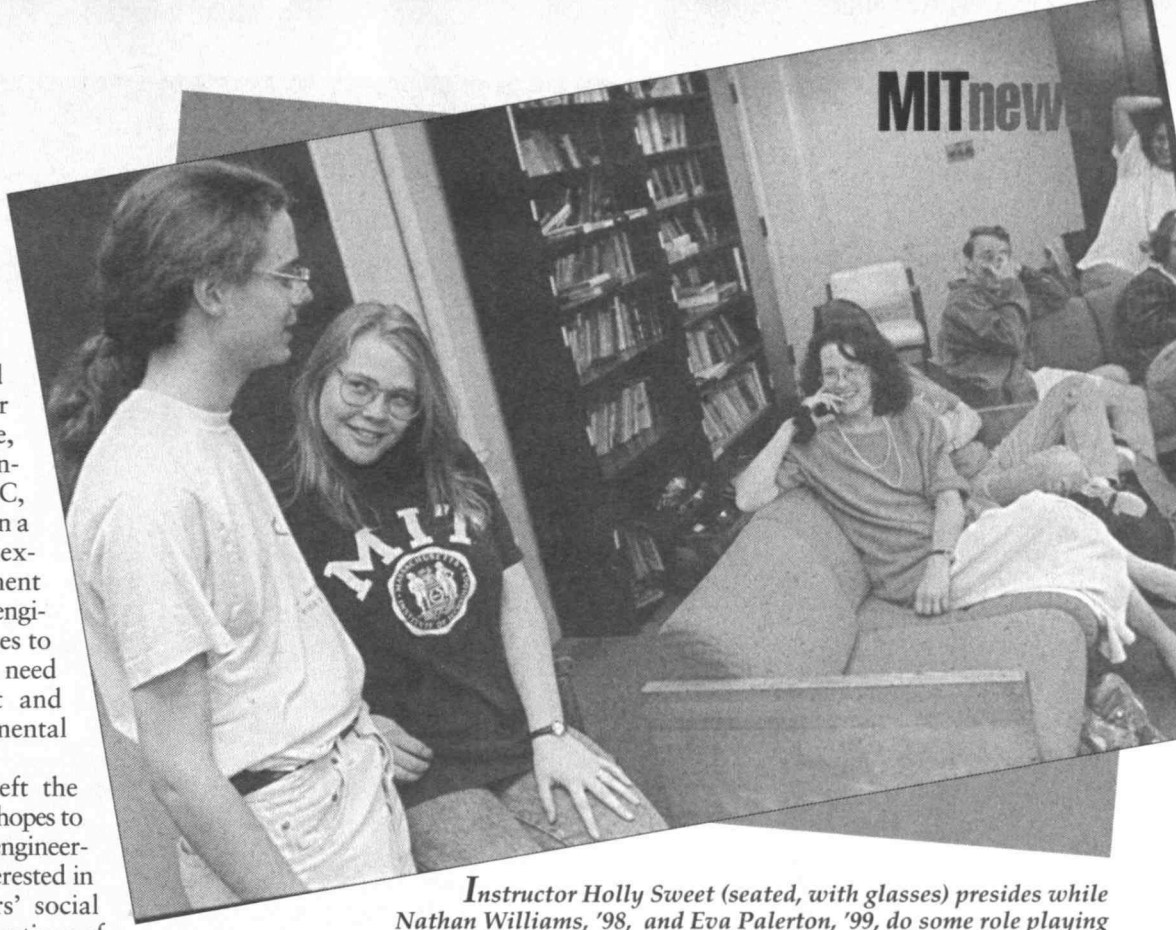
Weatherall first arrived at MIT in 1956, starting in the office of the dean of students, later serving as an admissions officer and as an executive officer of the graduate school. In 1966, MIT granted Weatherall a leave of absence to assist a two-year National Research Council (NRC) study of postdoctoral education. "Ever since then, I've been thinking about the motivations of engineers and

PHOTOS: L. BARRY HETHERINGTON

what they're into," he says. Even after returning to MIT, first as assistant dean of the graduate school and finally as the director of the careers office, Weatherall remained involved with the NRC, serving as a consultant on a number of studies, for example, of the employment of young scientists and engineers in advisory services to government and on the need for staff development and training for environmental fields.

Now that he has left the careers office, Weatherall hopes to write a book about the engineering profession. He's interested in the topics of engineers' social backgrounds, their perceptions of how they fit into the rest of society and business, and how the rest of society and business sees them. "The profession is too modest about itself," he says. "Engineers have defined themselves as a profession of employees and see others as the natural top dogs. It's a very unreasonable way to look at things."■

—*Leslie Brunetta*



Instructor Holly Sweet (seated, with glasses) presides while Nathan Williams, '98, and Eva Palerton, '99, do some role playing in last spring's session of the seminar on gender relations.

He Says, She Says. . . and Why

The students in the seminar run by Holly Sweet and Lee Perlman aren't designing the next smart machine or solving urban gridlock. But what the students gain from "Sex Roles and Relationships" may mean more in their lives than any particular leap in technology, because the seminar's goal is to help them better understand and get along with the opposite sex—personally and professionally.

The learning isn't always easy, either. Peggy Anderson, now a sophomore, remembers one class exercise intended to teach something about the male experience. The women in the class were told to remember the saddest time in their lives and all the details surrounding it, then describe it in a typically male manner by trivializing the event, "with extra points if you could make someone laugh," Anderson says. "That was really hard."

Tom Rinde, a senior in chemical engineering, remembers another exercise in which he had to play the role of a student who was left out when a male lab partner went out to dinner with the professor. Instead of getting angry at his fellow student, Rinde was expected to express disappointment and sadness, a more typical female response.

"That was really the beginning of understanding how differently (the two sexes) act," says Rinde, a fraternity member with lots of experience working collaboratively with men. "When I acted sad, my partner in the exercise felt uncomfortable. The role-playing didn't really flow, it didn't feel natural."

For those who fancy that MIT students of today would be too enlightened to be locked into gender roles, the seminar students and teachers can quickly identify some common MIT experiences:

- On this campus, the "male answer syndrome" prevails, in which men feel they *have to* have an answer to everything—questions in class or casual conversation—and they *have to* be right.
- Women feel their intelligence can be overlooked, as when a group of male and female students are working together on a problem set in physics and a male looks past a woman to ask another guy for help.
- Women feel pressure to be attractive, but not too attractive, or they won't be taken seriously.
- Women are reticent to answer questions in class or to challenge an answer proposed by a male.

But in the gender-roles seminar, those dynamics change. Women speak up, question a man's opinion, correct his assertions. "Men aren't on their own territory here," says Perlman, a political science professor who has been teaching for 12 years in the Experimental Study Group, the academic program that initially sponsored the seminar. "In the area of gender, women are wiser."

Given that situation, the ability of the class to attract almost as many men as



MORE THAN 300 MEMBERS and guests gathered at the Museum of Fine Arts last spring to celebrate the 50th anniversary of the MIT Club of Boston. The occasion included music and dancing, plus presentations by alumni and alumnae artists and an exhibition of their works—quilts, photographic prints, holograms, paintings, and movies. In fact, the gala was reported in the "Party Lines" section of the **Boston Globe**—*not a place where one usually looks for news of MIT.*

The anniversary offered an opportunity to recognize the club's past presidents (in the photograph above) for the contributions they have made to it's vitality and longevity. First row: Susan Schur '60; Karen Mathiasen, SM '71; Charles Hieken, '51; and Joan Martin Roth, SM '81. Second row: Klaus Kubierschky, '64; Glenn Strehle, '58; John Stelling, '56; and Robert Cowan, '49. Third Row: Thomas O'Connor, '60; George Macomber, '48; Panayiotis Spiliakos, '66; and Jorge Rodriguez, '60.

PHOTO: GARY GOODMAN

He Says She Says
continued

women in recent years derives from one ground rule: no blaming or shaming of either sex. Students are taught that it's hard to conform to either set of norms, male or female.

"The men say it's nice to be there, they don't feel attacked," says Sweet, a psychologist who is the associate director of ESG. In fact, she says, "the people who have the hardest time in class are the radical feminists who don't think we should spend any time worrying about what's hard for men.

"It's an invisible thing, how hard it is for men," Sweet believes. "Women have had 25 years of feminist training in unconscious sex-role strain, but men are just beginning."

Although having the course taught by a man and a woman working together makes it more effective, it sometimes happens that the two instructors disagree, not only because of gender but because of background. Perlman comes at issues from the systems perspective of a political scientist, while Sweet is grounded in psychology and the individual. But that, too, supports the learning process, the teachers believe, because students see that understanding other perspectives does not require the abandonment of one's own ideas.

There are those who think that a course on relationships sounds lightweight by MIT standards, even for a one-credit undergraduate seminar. Not so, says Travis Merrit, dean for undergraduate academic affairs, whose office is now its sponsor. The course—combining readings and papers with the experiences of fellow students and the instructors—clearly responds to a critical need. It has stood the test of time, gaining popularity over the 11 years it has been offered while adding new texts from the growing field of gender studies.

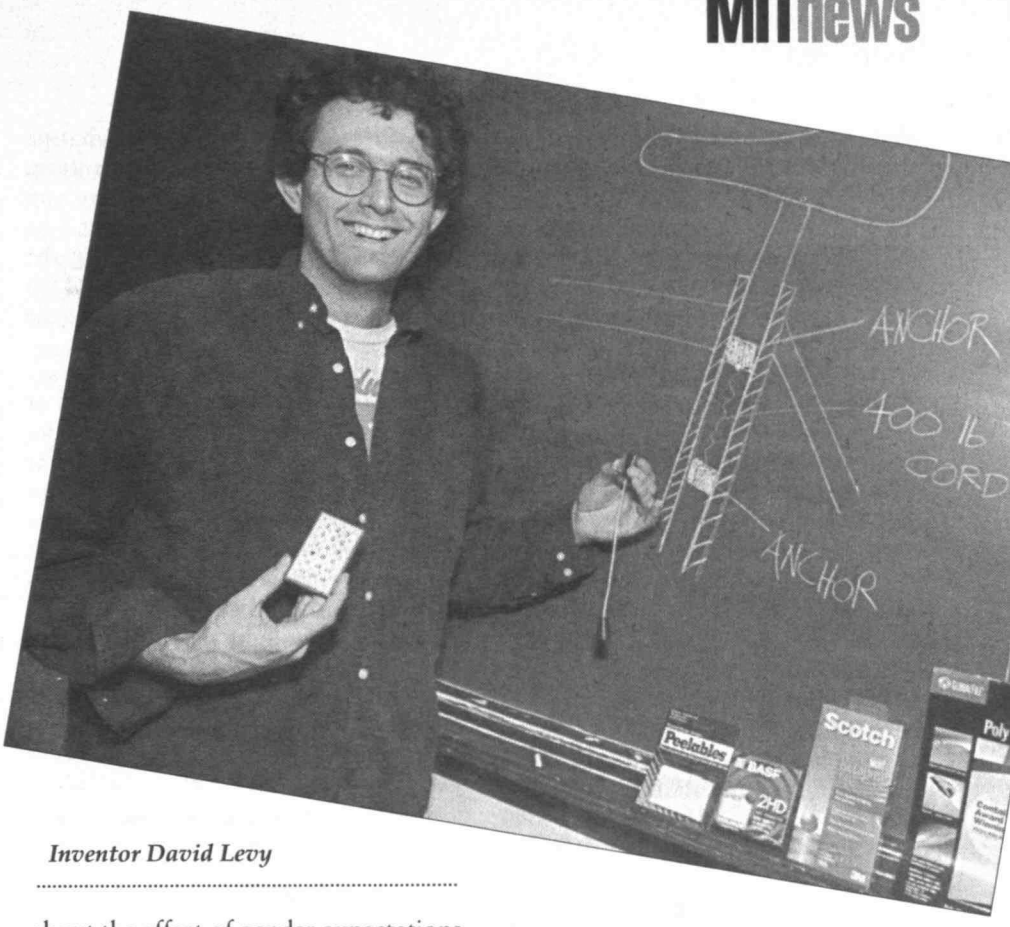
In a world in which gender-role learning runs deep, Perlman and Sweet say they aren't expecting any sea changes in just one semester. The goal instead is to "make people aware of the norms, so they can decide which they want to keep, which they don't," says Sweet. The instructors want their students to develop coping skills as well as compassion. And an assignment calling for interviews about the effect of gender expectations on the lives of their parents gives students a perspective on how relations between the sexes have evolved in the space of one generation.

In the last few years, Perlman and Sweet have taken their expertise on the road as the Cambridge Center for Gender Relations, offering training sessions and workshops to businesses, other schools, even other areas of MIT—including new MBA students at the Sloan School.

"People are starved for this," says Perlman. "It's often the first time they've had the chance to talk about gender relations without blaming."

Surprisingly, a recent peer-training session the two offered at Gettysburg College in Pennsylvania shed some light on one way in which the MIT student experience is unusual. "At Gettysburg, students said they get into intimate relationships too quickly, and they don't know how to be friends with the opposite sex," Perlman says. "Here, students probably need to know more about how to have relationships, but the nice thing is that there are lots of male-female friendships."■

—*Lisa Watts*



Inventor David Levy

$30,000 Prize for Applied Fantasy

When a guy invents devices as varied as a lock for a bicycle seat, an apparatus to speed the surgical connection of blood vessels, and a keypad the size of a credit card, *and* establishes a company to market these inventions, all by the age of 33, what does he do for an encore?

In the case of David H. Levy, '87, SM '87, now a candidate for a PhD in mechanical engineering, he wins the 1996 Lemelson-MIT Student Prize, worth $30,000.

The annual prize, awarded this year for the second time, goes to an MIT student who demonstrates unusual inventive ability. It was announced in May by Lester Thurow, Lemelson Professor of

PHOTO: MIT NEWS OFFICE/ DONNA COVENEY

$30,000
continued

Management and Economics at the Sloan School and chair of the Lemelson-MIT Prize selection committee.

One of Levy's simplest and most profitable inventions to date is Peelables, a stack of labels being marketed for use on video cassettes by 3M. To relabel a cassette, the user needs only to peel off the used label to expose a clean one beneath.

"I've lived on the profits from that label for a couple of years," said Levy, who has marketed Peelables and other inventions, such as his Wedgie bicycle-seat lock, through Th, Inc., (a play on the word "think") a company he founded in 1989. In addition to starting his company during the interval between completing a bachelor's degree and starting graduate school in 1992 , Levy also worked for Apple, Inc., for five years.

Levy, who holds five patents and has several pending, cites a series of invention philosophies as being key to his success. Primary among them is what he calls the curse method of invention. "Every time someone curses, there's an opportunity to invent something," he believes. Levy started developing the Wedgie, for example, when one of his friends went ballistic because his bicycle seat was stolen.

Then there is what he calls the "having your ear to incongruity" method of invention. The medical device provides a case in point: When a cardiovascular surgeon mentioned to Levy at a party that reconnecting blood vessels can take up to 20 minutes for each one, it struck the young engineer as being incongruous. Although he knew nothing about surgery, he thought that was far too long a time for such a procedure in this high-tech age, and decided to do something about it. The result is a device that cuts the reconnecting time for blood vessels to seconds.

The young inventor also makes extensive use of fantasy to develop inventions. "Just ignore reality and decide what it is you really want the world to be like," Levy explains, "and once you've identified something like that, fulfill it." It's that kind of thinking that led to his Micro-Miniature Ergonomic Keypad.

Applying the fantasy method, Levy went through what he calls his "Saturday morning invention time" phase several years ago. "The rule was," he says, "that I couldn't get out of bed until I invented something." On average, it took him no more than an hour and a half.

Levy expects to receive his doctorate this academic year, following which he plans to teach and continue inventing. "Invention," he says , "is an extremely difficult, extremely rewarding career. It allows you to walk through every segment of your life constantly aware of what's going on around you and actively working on making the world a better place."■

—*Victor Chase*

Gordon Brown

Pioneer Electrical Engineer and Educator Dies At 88



Professor Emeritus Gordon S. Brown, '31, ScD '38, a pioneer in electrical engineering, computers, and engineering education, died August 23 at his retirement home in Tucson, Ariz. Brown, a former resident of Concord, Mass., and Grantham, N.H., would have been 89 on Aug. 30. His family said he died of complications resulting from cancer.

Brown was recognized internationally for his pioneering work in automatic feedback-control systems, computer technology, and the numerical control of machine tools. During World War II, he and his colleagues developed automatic fire-control and aiming systems for guns used by the U.S. military.

As a faculty member, head of his department, and dean of the School of Engineering from 1959 to 1968, "Gordon Brown influenced the directions of engineering education in the past 50 years more than any other single person, " says Professor Paul Penfield, who now heads the MIT Department of Electrical Engineering and Computer Science. "Gordon's engineering-science approach, stressing fundamental science, today forms the guiding principle behind most if not all engineering education, in all disciplines, at MIT and elsewhere."

Brown was the co-author, with the late Donald P. Campbell, of *Principles of Servomechanisms*, published in 1948 and still a standard reference in the field, and over the course of his career was the author of more than 50

PHOTO: MIT NEWS OFFICE/ MARGO FOOTE

technical and professional papers.

Jay W. Forrester, SM '45, now Germeshausen Professor of Management Emeritus, remembers serving as a research assistant in Brown's laboratory. "He's been my mentor since 1940, the major influence on my career," says Forrester, who went on to invent core memory and the field of system dynamics.

In remarks he made in 1990, on the 50th anniversary of MIT's Servomechanisms Laboratory, which Gordon Brown founded, Forrester said that Brown "always kept a close tie between theory, research, and the real world. He continuously had the end result in mind."

"Gordon was forever ready to do battle with self-appointed guardians of the past," Forrester added. "He frequently made the observation that 'the only steady state is the steady state of change.'"

Brown was born in 1907 in Australia and graduated from what is now the Royal Melbourne Technical College. He went on to earn three MIT degrees and joined the faculty in 1939, the same year he become a naturalized American citizen. Brown's doctoral thesis was on what was called the cinema integraph (because it employed motion picture film), which was a precursor of the analog computer. Having recognized the future for computers and automation, he founded the Servomechanisms Laboratory in 1940, where work was done that led to the development in the late 1940s of the first major digital computer, Whirlwind.

After World War II, Whirlwind became part of MIT's Lincoln Laboratory and Lincoln's all-important development of the SAGE system of air defense for the North American continent. The work of the Servomechanisms Lab led to numerical machine control and the Automatically Programmed Tool Language (APT), which revolutionized modern machine work worldwide and has had a lasting effect on industry.

In a memorial tribute, *Boston Globe* economics writer David Warsh cited Brown's visionary role in the history of computers and credited his Servomechanisms Lab for contributing to this state's high-tech industrial development.

In 1952, Brown, as head of what was then called the Department of Electrical Engineering, launched a major program to restructure and revise the entire departmental curriculum, basing the teaching more firmly than ever before in fundamental sciences such as physics and mathematics. These changes soon were to be taken as models by electrical engineering departments in schools throughout the nation and abroad.

"Brown influenced the directions of engineering education in the past 50 years more than any other single person."



When he became dean of MIT's School of Engineering in 1959, Brown extended to other engineering departments those same principles of curriculum revision. To the dean's office, however, he brought added zeal on behalf of the principle of interdepartmental, interdisciplinary research as embodied in the idea of the "research center." The concept grew and, once again, technical and engineering schools worldwide reconfigured themselves in similar directions, using the MIT experience as a model.

Still another dimension of Brown's tenure as dean of engineering was his push for international cooperation and the transfer of technology to other societies. He took a lead role in establishing MIT interactions with institutions in India and Singapore and with the Technical University of Berlin.

Brown continued as dean of engineering until 1968, when he became the first holder of the Dugald Caleb Jackson Professorship, named for the man who was head of the MIT's Department of Electrical Engineering when Brown arrived as an undergraduate. In 1973, Brown was further honored by his appointment as Institute Professor, a rank MIT reserves for its most distinguished faculty members. He retired in 1974. In 1985, Building 39 was refurbished to house the Microsystems Technology Laboratories and named the Gordon Stanley Brown Building.

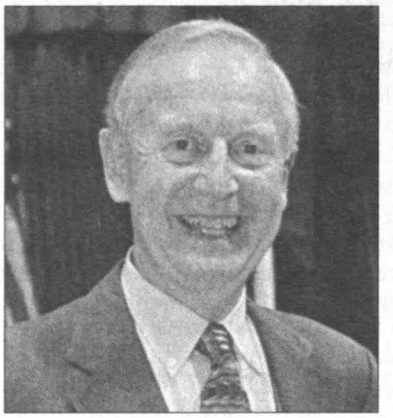
Brown did not lay aside his dedication to achieving change when he retired from MIT. In the 1980s, working with Forrester, Brown introduced system-dynamics thinking into K–12 education in the Tucson public schools. (The field of system dynamics, which grew out of feedback concepts pioneered in the Servomechanisms Lab, deals with the feedback effects of diverse but interconnected systems—social, natural, and physical.) In the process, Forrester has said, Brown launched "a revolution in education" in the Catalina Foothills school district where he lived.

In the Tucson program, which was reported in some detail in the February/March 1995 issue of *MITnews*, Brown started by working with an eighth-grade teacher of biology, loaning him software that demonstrated how feedback concepts could have a place in the classroom. "The ideas took hold," Forrester said. "The classroom was transformed."

Brown negotiated with Apple Computer for a gift of $100,000 worth of computers for the same teacher's classroom. He then brought in the principal of the junior high and finally the superintendent, the school board, and parents to see what was going on in the classroom, and the systems approach spread to other subjects and other schools in the district

Two memorial services have been planned, one at a Catalina Foothills school in Tucson and another at MIT (at 4:30 p.m. November 8, in Room 34-101). Donations may be made to the Gordon Stanley Brown Fund, which promotes system-dynamics teaching in schools. Contributions should be addressed to Alexander Pugh, treasurer, System Dynamics Society, 49 Bedford Rd., Lincoln, MA 01773. ■

— KENNETH D. CAMPBELL, director of the MIT News Office.



Delivering the Educational Goods

In this letter I want to talk about the way continuing education may be delivered to alumni/ae in the future, and I'm hoping I can inspire you to give the topic some thought and make your thoughts known to us in the Alumni/ae Association.

You are all aware that a knowledge revolution is underway—propelled by the twin engines of computers and communications technology—that is fundamentally changing the rules of supply and demand and the way all forms of information are delivered. One vehicle for exploiting those technologies is "distance learning," through which students can work with resources beyond the classroom walls and learners in remote locations can share the classroom experience.

MIT is involved in a broad-based effort, coordinated by its Center for Advanced Educational Services, to explore innovations in distance learning that can serve working professionals. There is also an Institute-wide committee to consider new applications of computers and communications technology to teaching and learning. One application made its debut in the fall of 1995, when the Sloan School and the School of Engineering jointly launched the Systems Design and Management (SDM) Program.

SDM is the Institute's first degree program based on distance learning, allowing students to complete most of the course requirements for a master's degree at their job sites. It is now in its pilot phase, with eleven students at eight corporate locations. The program includes two courses made up of students both on campus and at the remote sites who meet weekly in a "virtual-classroom" videoconference, which they prepare for through lectures distributed on videotape.

MIT expects videoconferences in general to offer a rich exchange of ideas and visuals that will improve the level of learning. Just how effective the technology can be was brought home to some 2,000 alumni/ae and others when Webmeister Tim Berners-Lee made an enthusiastically received videoconference presentation to a number of Enterprise Forum audiences coast to coast in June.

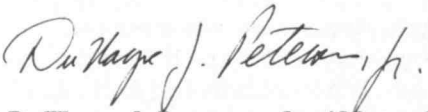
There are good reasons, however, why MIT should proceed slowly in developing new distance-learning programs. For example, MIT must consider whether it has the expertise and resources to expand into areas—such as post-graduate professional education—that it has heretofore left to other institutions. Wiring classrooms is not cheap, nor is the production of high-quality video lectures. At a time when budgets are constrained and faculty time is limited, such expansion could have an impact on the Institute's core educational mission.

On the plus side, distance learning has the potential to enrich course offerings, enhance the learning environment for resident students, generate new sources of tuition revenue, and reduce instructional costs. But if that potential is to be realized, realistic goals must be established and all the stakeholders, including alumni/ae, must participate in thinking it through.

The current efforts to expand continuing education will undoubtedly follow more traditional routes, such as making faculty and other resources of MIT available to alums who live outside Boston. The call for such outreach is certainly voiced by all of us who live on the West Coast. A move in that direction is the Speakers Bureau now being organized by the Alumni/ae Association, which is expected to help clubs and other groups schedule presentations by traveling faculty members. But new technologies also will open up a new range of options. Information can be customized for the individuals or groups, and the topics for outreach can go beyond the strictly educational. Career-planning, reunion organizing, and the business of various Association Board and Visiting Committees, for example, could be facilitated by technologies such as videoconferencing, with savings in volunteer time, energy, and travel costs.

It is impossible to predict the ultimate applications of any specific technology, or to predict whether its benefits will exceed its costs. But we know that MIT and other colleges and universities must learn how to adapt and exploit technology to deliver an enhanced, accessible product at lower cost, or they will be left in the dust by smaller, more flexible educational organizations. Already, centers for innovation in management education are being set up outside traditional business schools. Interest in educational enterprises run by large corporations is also on the rise. A number of U.S. companies have had such programs for decades (the General Motors Institute in Detroit, for one) and many of these programs have working arrangements with universities that could become models for future development.

In this fluid educational and technological environment, it is the job of the Alumni/ae Association to be aware of new technologies and to promote those that will help deliver services most valued by alumni/ae—effectively and at optimal cost. To do that, the Association's staff and volunteer leaders need to know what services you need and how you would like them delivered. Let us hear from you. Please contact me at (818) 577-9419 or by e-mail at <duwaynep@cogent.net>.■



DuWayne J. Peterson, Jr., '55, president, Association of Alumni and Alumnae of MIT for 1996–97.

PHOTO: L. BARRY HETHERINGTON

ClassNotes

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Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200
77 Massachusetts Ave.
Cambridge, MA 02139

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Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200
77 Massachusetts Ave.
Cambridge, MA 02139

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Unfortunately, we have three deaths to report. Nancy Snyder McCumber writes to tell us that her father, **Roy D. Snyder** of North Carolina, died May 26, 1996, at age 97. She says her father had a great affection for MIT and spoke often of his years here. The last time he visited Cambridge was in June 1991, when he attended Tech Night at the Pops and his 70th Reunion. For the past three years, he lived at the Forest at Duke, a continuing care retirement community in Durham, N.C., where he was very happy and had many friends. She goes on to say, "We will remember him for his zest for life, his optimism, and his wonderful sense of humor."

Mahlon A. Hartley of Churchville, Va., passed on November 15, 1995. He was the owner of M.A. Hartley and Co. in Staunton for many years. Surviving are a daughter, Justine H. Cleveland; five grandchildren, and two step-grandchildren. He was preceded in death by his wife, Kathryn Sheep Hartley, and by a son, Richard A. Hartley. . . . **Michael "Mike" Naigles** of Yonkers died September 25, 1995. At this time we have no further information on him.

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22 75th Reunion

Please send news for this column to: Class Notes Editor, *Technology Review*, MIT W59-200, 77 Massachusetts Ave., Cambridge, MA 02139

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Please send news for this column to: **Royal Sterling**, secretary and president, Apt. D201, 2350 Indian Creek Blvd. W., Vero Beach, FL 32966-5103

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I have just received word that **George Te Chih Wang** passed away April 29, 1996, in his sleep at his home in Port Washington, N.Y. He was the husband of the late Jeanett K.C. He is survived by three sons: Robert, Peter, and Paul; and two grandchildren: Timothy and Katherine. George was a graduate of Tsing Hua University, 1920. He came to the United States as a Boxer Scholar, then attended MIT. He was in the diplomatic service for the Chinese Nationalist Government during WWII, and later an international business executive as trade and technical consultant with China. George was loved for his keen sense of humor, kindness, and intelligence. Condolences to all the family.

Yours truly has been traveling around. May saw a cruise on the three rivers in Europe, one of the best cruises I have ever been on. Then in July, I visited my daughter in Plattsburgh, N.Y. That was fun. She had every minute planned—plays, dinners, horseshows, etc.—Co-secretaries: Col. **I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480; **Katty Hereford**, 237 Hacienda Carmel, Carmel, CA 93923

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Ed Harris reports on a trip he and Mary enjoyed on a small ship cruise. They touched Aruba, Antigua, Portugal, the Madeiras, and three islands in the Azores. The four new countries or island groups, when added to the 98 he had previously visited, makes a total of 102—which entitles Ed to membership in the Travelers Century Club.

A memorial service for **Sam Spiker** took place at Emmanuel Church in Dublin, N.H., on July 13, 1996. The service was followed by a reception at the Spiker home just around the corner from the church.

It is with sorrow that the passing of **Kenneth T. Bainbridge** must be reported. He died on July 14, 1996, at his home in Lexington, Mass. He received SB and SM degrees in electrical engineering, then went on to Princeton where he earned a PhD in physics. In the summer of 1943, Dr. Robert Oppenheimer recruited Ken to be a group leader for the Manhattan Project at Los Alamos, N.M. The following year, he was named director of the Trinity project, which exploded the first atomic bomb—a plutonium bomb—on July 16, 1945. Ken was among the scientists who watched the blast. Throughout his career, Ken was professor of physics at Harvard University.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., Chatham, MA 02633

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As your neophyte secretary, I am somewhat breathless and have little to say, especially after that wonderfully entertaining report of **John H. Wills**, your acting class secretary for the last *Review*. We knew each other, of course, in the Roaring Twenties, but I make a point of it because of the important bearing of some of my MIT friends on my life. We lost track of each other after leaving the Institute until some decades later when we joined forces to form a highly successful New York law firm. My friends in that venture were **Ted Faithful**, Bill Sonnekalb, '25, John Hoxie, '25, Cy Hapgood, '33, Cap Schneider, '44, and Stan Amberg, '60. Our practice was known as Intellectual Property Law, but we preferred to be called Patent Lawyers which, although less elegant, was good enough for the judges before whom we tried our cases.

Martin Luther Grossman writes from Charlotte, N.C., expressing his appreciation (which I second) for the services of **"Win" Hartford**, also from Charlotte, in substituting for class secretary, but pointed out an error that Grossman was from Holland based on the news that he went figure skating on his 90th birthday. . . . Frank Phillips, '36, sends the following: "Last May, my wife and I moved back to New Jersey from Sante Fe, where I had enjoyed the company of **Malcolm Epstein**. We saw each other occasionally at functions of the new MIT Club of New Mexico and at church. I understood from a vestryman that his wisdom is still tapped from time to time, to the church's benefit. We had looked forward to reuning together in Cambridge—his 70th and my 60th—but his 91st birthday intervened. His children and grandchildren came in waves from various parts over a three-week period. Malcolm remains hale, hearty, and a loyal '26 alumnus."

We have reports of three deaths. **G. Warren Bates** passed away at River Woods in Exeter, N.H., on November 29, 1995. He received a master's degree from Boston University in 1939. During WWII, he served as a captain in the Air Force. A mathematics teacher, he taught at Mercersburg Academy, Newburyport High School, and Medford High School, as well as Northeastern University. Mr. Bates was organist at the Second Congregational Church of Cohasset for 50 years. He was past master of the Konahasset Lodge in Cohasset. He was predeceased by three wives, the late Emma Bates in 1989, Hylma Bates in 1968, and Minnie Bates in 1935. He is survived by six children, 17 grandchildren, and 20 great-grandchildren. . . . **Clifton B. McFarland** died on January 30, 1996. He was born in Chelsea, Mass., and worked for the Pennsylvania Railroad from 1926 to 1931. He was the oldest member of the S.C. Society of American Civil Engineers, joining in 1934. A U.S. Navy veter-

an, he was commissioned as a lieutenant in 1939, served in Scotland during WWII, and retired as a captain in 1967. He was a 33rd degree Mason. He is survived by his wife, Mary Boykin McFarland, three children, nine grandchildren, and nine great-grandchildren.



Walter Lobo

Walter E. Lobo, a chemical engineer who gained international prominance as an authority on the design of cracking furnaces for producing petroleum products, died November 10, 1995, in New Canaan, Conn., at the age of 90. During WWII, he led a team of Kellogg engineers in the design of small, skid-mounted air separation units to produce oxygen. These units were transported by ships to provide breathing oxygen for Allied aviators as their bases were relocated to the European continent. Lobo retired as director of Kellogg's Chemical Engineering Division in 1959 to establish a private consulting practice in New York City. His firm's clients included the leading oil and chemical companies in Europe, the U.S., and Japan. Our sympathies go out to the families of these three classmates.

Please send news for this column to **Richard Whiting**, secretary, 870 United Nations Plaza, New York, NY 10017-1807; tel: (212) 751-5057.

27 70th Reunion

We regret to report two deaths of our classmates. **Roger L. Nowland** of East Blue Hill, Maine, died on November 29, 1995. He had used a motorized wheelchair for many years. He and his wife, Linda, lived in an attractive home that he designed and built in 1972 on a ledge next to a tidal flow stream. The fascinating feature, besides their picture windows overlooking Blue Hill Bay, is a turret watch tower study with a telescope. Roger was a consulting engineer in Greenwich, Conn., with his product-design consulting firm, Nowland & Schladermundt, from 1943 until he retired in 1963. Such ideas as storage of food in refrigerator doors and ice cube trays were a couple of his contributions.

The high point of Roger's career was his partnership with Norman Bel Geddes, who conceived the idea of the "City of the Future" for the General Motors exhibit at the New York World's Fair of 1939–40. Geddes was the futuristic artist and Roger the practical engineer to design the farsighted highway system, with moving vehicles at different speeds in multilanes with huge cross-overs—structures and highways that are commonplace today.

Joseph S. Yates of Bartlesville, Okla., died on May 30, 1996. He, his wife, Harriett, and daughter, Joanne, lived in Wyandotte, Mich., during his working years as a mechanical engineer with BASF Wyandotte Corp. He was a registered professional engineer in the states of Michigan and Oklahoma and a member of the Engineering Society of Detroit. He retired in 1969 and later moved to Bartlesville to be near their daughter and son-in-law. Joe was an avid golfer all his life.

We extend our condolences to the families of these two classmates.

We hope that many of you are planning to attend our 70th Reunion celebration with your wives in June '97.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

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As our class advances in the geriatric category, we can only expect the loss of members to keep pace. Unfortunately the pool of active members is therefore being depleted and no corrective measures are available or anticipated. The following deaths are reported with regrets and our sympathy offered to family and friends.

Carl Henry Rumpel passed away on February 21, 1995, in the 500 Village Place Health Centre at Longwood, Fla. Carl had retired in 1968 from Bell Laboratories in New Jersey.

Theodore Davos Money died on May 1, 1994, at his home in Berkeley, Calif.

Jean Brand Bennedsen died on July 1, 1996, at her home in Orinda, Calif. Jean was a leader in the advancement of women in the professions. Starting as a student in architecture, she switched to mechanical engineering to become a power plant engineer, eventually with nuclear power plants.

Mariano Jesus Contreras died in August 1995, presumably in Caracas, Venezuela, from information at hand. Mariano returned to Venezuela after graduation and was in governmental and industrial engineering throughout his lifetime. . . . Mariano was brother-in-law to **Gabriel Disario**. Gabe has been in the United States this year in connection with daughter Caroline's Class of 1956 40th Reunion at MIT. Both "Duke" and "Gabe" have traveled extensively through the years and attended our reunions.

Another of our well traveled classmates, mostly in Asian countries though now retired from travel, is **Henry Buntschuh**. He now seasonally shuttles between New Jersey and Arizona, visiting his son, Robert, '55.

Henry (Hank) Lamb sends news of a special occasion. His grandson, Bob Steen, currently a leader on the Genome Project at Whitehead Institute at MIT, turned 30 this year; daughter Pat turned 60; and Hank turned 90 this year. "Since we thought 30, 60, 90 was unusual in one family, we decided to throw a big party, inviting all our relatives to help us celebrate at a clambake on Lake Sebago on Raymond Cape in Maine in August."—**Ernest H. Knight**, secretary/president, 168 Ai Plummer Rd., Raymond, ME 04071

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We have two deaths to report. **Angelo M. Altieri** of Watertown, Mass., died June 26, 1996. Altieri worked as a chemical engineer for Teleston and Hollingsworth, a Hyde Park paper manufacturer company, for 37 years. He leaves his wife, Rose M. Cavaretta, two daughters, a brother, several grandchildren, and five great-grandchildren.

The date of death for **Eugene C. Koo** of Philadelphia is unknown. Professor Ku at UPenn informs us that Eugene went back to China and taught at several universities and served as director of the National Bureau of Industrial Research, Ministry of Economic Affairs. Eugene's "scientific papers" were just published. His most significant contribution, "The Friction Factors for Clean Round Pipes,"was published in *Transactions of the American Institute of Chemical Engineers*.

Our sympathies to the families of these classmates.

Please send news for this column to: Class Notes Editor, *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

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One of the most gratifying experiences a class secretary can have is to receive a letter from a classmate from whom he has not heard in many years. In this case, it was **Russell Stetson**, who now lives in Osterville, Mass. Rus's last appearance was Class Notes, December 1964. In the update, he reveals that after "17 years at Monsanto in Everett, Mass., finally designing equipment for the research lab and pilot plant," he became the first employee of Emerson & Cuming in 1950 and "finally tapered off to full retirement in 1978." More recently he and his wife, Louise, celebrated their 60th wedding anniversary at "a grand party, attended by both sons and spouses plus all six grandchildren and seven of the eight great-grands." Last Christmas, he was in surgery getting a full hip replacement. He had fallen while spreading sand on the driveway. . . . **Ernie Tauch** reports from Jacksonville, Fla., that at age 92 his doctor tells him his health is good for his age. Last November was a very bad month for him when his wife Katherine, to whom he had been married for 63 years, died of a sudden stroke. Ernie says photography continues to be his principal hobby. Wesley Manor, where he now lives, is located in a beautiful setting of majestic trees on the bank of Julington Creek, a major tributary of the St. Johns River, and he supplies the Village Store with an abundance of photoprints of scenic views. . . . From Hilton Head, S.C., **Dave Houston** reports that he recently celebrated his 87th birthday, that he plays golf when it's not raining, that he has given up sailing, and that he plays bridge frequently, whether the weather is good or bad. . . . **Helen Thornton** has moved across the Hudson River to Kingston, N.Y. She now has a second great-grandchild, Christopher Albano. Current activities include gardening and reading. . . . Despite the fact that they are now both in wheelchairs, **Joe Kania** and his wife, Florence, recently traveled from their home in Vancouver, B.C., to Alaska aboard Holland America's *Westerdam*. My records indicate that, at age 95, Joe is our oldest classmate.

We regret to report that another of our classmates has passed away. **William F.R. Griffith, Jr.**, died in Tucson, Ariz., on June 17, 1995. Bill was for many years a consulting engineer in Tucson in mechanical construction and air-pollution control. Also he was the chief of the Pima County Pollution Control Department. His hobbies were golf, boating, fishing, and traveling. As of the time he last wrote (February 1994), he reported that he was "hale and hearty at 86." He had just



Albert R. Sims, '31 class secretary, comments: "Go Oldsters, attending what will probably be the last five-year reunion for many of us." . . . And to Polly (Mrs. Kenneth J.) Germeshausen, '31, "one of our greatest benefactors: It was good of you to stop by our table and say hello." From left, above: Bill Kay, Norman Fitzgerald, and Edward Blake, and below: John McNiff and Leo Green, at the T-Day Luncheon.



returned from climbing Chichen Itza pyramids in Yucatan, Mexico. Bill is survived by his wife, Estelle; a son, William F.R. Griffith III, a VP of American Cyanamide; a son, Charles, a consultant in mathematics; and four grandchildren, including W.F.R. IV.

Please send news for this column to: **Gordon K. Lister**, secretary, 5707 Williamsburg Landing Dr.,Williamsburg,VA 23185

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I am indebted to **John Swanton, Ben Steverman, Sheldon Smith,** and probably several others who attended the 65th Reunion, as well as the Alumni/ae Office, for filling in for me on the last submission to the *Review*. As I did not return to Florida until June 12, I was not aware of schedules and reporting needs and had very little information to report.

Upon returning to Florida I had a letter from **John Swanton**, saying that his wife, Louise, "had survived very well without me." Louise had declined attending the Reunion because of the stress of the long auto ride. (In my own case, Lillian decided "no" because of the walking. Lillian, like Louise, is mostly OK.) Like it or not, age does put up obstacles. . . . Following John's letter was one from **Gene Branca** with a note he had received from Timothy B. Barnard, one of three sons and two daughters of Janet and **Lawrence Barnard**. (John D., another son, is a member of the class of '63.) Timothy reported that his father had died in April (no date) after a short illness. Lawrence's wife, Janet, predeceased him in December 1984. Lawrence was for most of his working career a sales engineer for Lewis Shepard in Watertown, Mass. He was extremely active in community affairs, chairing a number of committees in Red Cross and other programs. In later years, he and his wife did considerable traveling, both here and abroad.

The Alumni/ae Office has forwarded to me death notices of two of our other classmates. **Edward Balch Hubbard**, who died on April 11, 1996, and **William Frank Robinson**, who died on May 21, 1995. Edward Hubbard was most faithful in his attendance at five-year reunions, missing none up to and including the 50th. (In checking the 50th Reunion book, I find that only one other person, **Donato Grieco**, achieved such a record. One other, **Richard Ashenden**, still among us, has missed only two up until this present time.) Ed was an investment broker who throughout his lifetime delighted in New England wildflowers, was a member of the New England Wildflower Society, a former member of the Annisquam Yacht Club, and the Weston Yacht Club. He leaves his wife, Charlotte; two daughters, a brother, five grandchildren, and two great-grandchildren.

The notice received on Bill Robinson mentions that he died in Houston, Tex. He was a textile executive who served during WWII as a lieutenant colonel in the Army. Subsequent to that, he worked as an insurance manager for Burlington Industries before retiring in 1972 to Harwichport, Mass., and then in the mid-1980s to Houston. His last activity was tutoring high school students for SAT exams. He is survived by his wife, Virginia, two sons, a daughter, two brothers, and five grandchildren.

We extend our sympathies to the families of these classmates.—**Albert R. Sims**, secretary, 1727 Bayshore Dr., Englewood, FL 34223; tel: (941) 474-8655

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65th Reunion

The Alumni/ae Fund reports that our class now has 152 active members. Seventy-five contribute to the Fund. In the year ending June 30, 1996, we contributed about $87,000.

John Brown is taking a two-week course at Carroll School for the Blind. He says that 85 percent of our intelligent information comes through our eyes. John, at the moment, is taking on the duties of class treasurer, and Elizabeth Simons of the Alumni/ae staff will watch over our incoming and outgoing figures. . . . **Don Brookfield**, our nominating chairman, would like our classmates to send him any ideas they may have. (You know our 65th Reunion is coming up fast).

Joseph B. Paul, 86, died in Los Angeles of Lou Gehrig's disease. In 1936 he opened a car dealership, and he was active in business until 1994. He participated in many civic and professional organizations. He leaves his wife, Mary, a daughter from his first marriage, and two grandchildren. . . . We have learned that

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Eric Ericson died October 9, 1995. When we receive some obituary information, we will pass it on.

All for now. Write!—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907-1643; tel: (508) 531-0053

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Foreward and forewarned: You may not enjoy reading these notes, which all deal with deceased classmates, but what has happened must be told. I received a belated notice from one of **Gertrude Elvira Ebbeson**'s sisters that Gertrude had passed as of August 22, 1988. She was one of three women and very few architectural graduates of the our class, and I came to know her as we both charretted in the old Rogers Building. Except for her WWII experience with the Army Corps of Engineers in Norfolk, Va., her whole career revolved about her cultural and business activities in Bangor, Maine. The Bangor Symphony Orchestra knew her as a violinist for ten years and as a board member, and she exhibited her watercolors in one-woman shows there and in Virginia. She was registered as an architect in Virginia in 1945, and in 1960 became the first woman architect registered to practice in Maine, where she worked with several Bangor firms before going into private practice. She is survived by five sisters and two brothers. Funeral services were held at St. John's Episcopal Church, where Gertrude was a member.

I can now report on **John Edward Bell** (X, SM'36), who passed on December 20, 1994. Gordon McBain, '50, VP/treasurer of the MIT Club of S.W. Florida put me in touch with Mrs. Ruth Bell, who sent a brief obituary notice from the Cape Coral newspaper. John Bell reported in our *25th Reunion Classbook* that he was manager for Sinclair Refining and had married Helen E. Bell in 1934, and that they had a son and daughter. Helen Bell



Tom Weston had a picture taken of some of those attending the 64th Technology Day. Standing: Don Brookfield, Mel Castleman. Sitting: Tom Weston, John Brown, Al O'Neil.

passed on in 1967. John Bell lived in Connecticut after MIT, but for the last 23 years he had been living in retirement in Cape Coral. He was associated with the local Kiwanis Club, the Cape Coral Cruise and Power Squadron Clubs, and the fraternity Sigma Zi Theta Chi.

Elna Iris Perkins (VII) passed on October 6, 1995, at the age of 92, after a lengthy illness. She earned degrees from the Universities of New Hampshire and Pennsylvania, then did graduate study in public health at MIT, which led to a 40-year career in that field. Her brother, John, provided us with an obituary from the Concord, N.H., *Monitor*, from which we learned that Ms. Perkins taught at the Pinkerton Academy of Derry, N.H., at St. Mary's Junior College of Raleigh, N.C., and at the Georgia State College for Women at Milledgeville, Ga. She was a health educator with state, county, and municipal tuberculosis and health associations, as well as with the U.S. Public Health Service and with the Pennsylvania Health Department. In retirement, she was active with the N.H. Association for the Elderly and the American Public Health Association, and she was a member of Unitarian groups in both Durham and Concord, N.H.

The passing of **Norma (van Druten) Koch** (VII, MPH '48) on December 1, 1995, in a nursing home in Greenfield, Mass., was reported in an obituary from the Greenfield *Recorder*. After graduating from the College of the Pacific and the Stanford School of Nursing, she earned a master's degree in public health from MIT. Mrs. Koch served as a school nurse in Greenfield and Gill and as a volunteer for the American Red Cross and the Franklin County Public Hospital for many years. She also served with the Girl Scouts of America. She was married to Eugene Koch, who died in 1994, and they left a son and a daughter. A memorial service was held in the First Congregational Church of Greenfield.

Charles Keller, Jr. (II) passed on April 10, 1996. He graduated from the U.S. Military Academy in 1930 and completed his education here at MIT in 1933. He was captain with the Corps of Engineers when WW II broke out, going on to be promoted to colonel and receiving a Bronze Star, the Legion of Merit, the Legion of Honor, and the French Croix de Guerre. He later founded the Keller Construction Company, which carried out many river and marine projects in New Orleans. In the 1950's, Charles and his wife, Rosa Freeman Keller, were part of a group that built Pontchartrain Park, a community designed to give African Americans a chance to own their own homes. Keller was a member of the President's Committee for Equal Opportunity in Housing and the President's Committee on Urban Housing, as well as a number of civic organizations in New Orleans. Charles and Rosa received honorary degrees from Loyola University's Law School and the New Orleans United Way's highest award for voluntary service, and they were the first couple to receive the Greater New Orleans AFL-CIO's Community Services Award. His survivors include Rosa and their two daughters.

The correct date of **Lewis William Moore**'s (X) passing was March 13, 1995. This was incorrectly reported in the *Technology Review* of January 1996. He was retired from the board of directors of Amoco Oil in 1970 after 37 years with the company and its predecessors. . . . Also in the January '96 issue of the *Review*, there was a brief reference to the passing of **Julio De La Fuente** (II). I wish to add a line from a letter from his daughter that her father had been planning a return visit to MIT with his wife when that intention was cut short by a heart attack.—**Berj Tashjian**, secretary, 1245 Briarwood Lane, Northbrook, IL 60062-4556; tel: (847) 272-8683

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Your secretary has a red face this month. In time for his July 11 birthday, I sent greetings to Brigadier General **Kenneth McCrimmon**. Shortly thereafter I received a letter. "Thank you for the birthday greetings to my father. However, he passed away two years ago. I know you must have forgotten as you did acknowledge this fact last September in a very nice note to me. Dad would have liked to respond to your request for information because he enjoyed keeping track of classmates and other associates from the various schools he attended and the organizations to which he had belonged."

Walt Hoffman responds from Fort Meyers, Fla., that his health is good and his wife is fine. They have three children and nine grandchildren. He keeps busy with golf, boating , reading, and stenciling. They make frequent trips to Birmingham, Ala., to visit a son who suffered a severe stroke in October '94, and to Dallas to visit their daughter. He reads constantly and likes adventure and blood and thunder subjects. He exercises regularly by walking and water aerobics. . . . **Rees Schwarz** sends us his picture taken at a family reunion in November '95 at Sunset Beach, N.C. He is still a handsome man after all these years. Rees enjoys good health as does his wife. They have three children and six grandchildren. He volunteers for fund drives, gardens, travels, and enjoys philately. He is also a fair bridge and chess player.



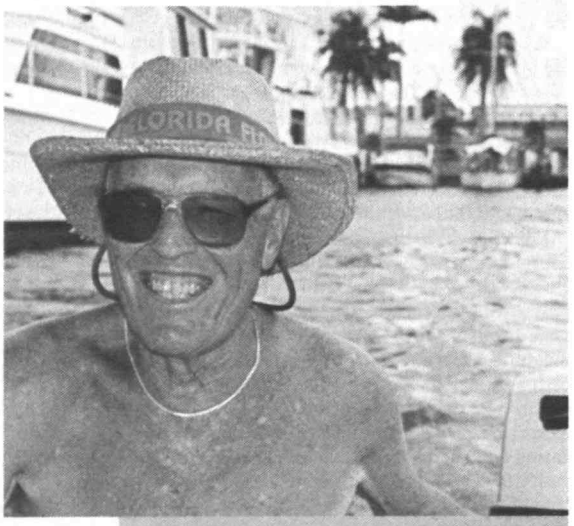
Rees Schwarz, '34, at Sunset beach, N.C.

Ernie Massa wrote with biographical information at the RCA Electronic Research Laboratory, "where we developed the electron camera tube and picture tube." After war service at Wright Field, he moved back to Cohasset, Mass., where he worked with his brother Frank ('27, Course VI) at Massa Laboratories in Hingham. He and his wife, Jeanette, have two sons: Ernest, Jr., and Ronald, both married, and five grandchildren. "No great-grandchildren yet. After 20 years of active and reserve duty with the Air Force, I retired as lieutenant colonel. In 1970, I retired from Massa Laboratories and moved to Pompono Beach, Fla., returning to Cohasset for the summers."

Ernie requested that we have a mini-reunion yearly. I will mention that there is a luncheon scheduled for May 13, 1997, place to be announced later.

Randy Thompson writes that he is having problems with his knee. He is widowed, but has three children, two grandchildren. He lists his recent trips: the doctor, the dentist, the grocery, and the gas station. He notes: "I don't believe any classmates will even remember me except possibly **Johnny Hrones** and **Eddy Sylvester**, with whom I played a lot of hockey. Although not now in good shape, I don't feel discriminated against by fate, as I did fine until the 80th birthday, and who can expect more?". . . **Matt Highlands** responds from Orono, Maine, that his health is fair although his wife has some health problems. He spends time reading "whodunnits," and exercises regularly. "At age 91, things go slowly. There's not much energy left.". . . **Norm Krim** notes that the new archives building for the Raytheon Co., where he is archivist, is almost complete. He invites visitors to stop in on the second floor of the old D.C. Heath building, on a hilltop overlooking the Raytheon headquarters in Lexington. Norm reports that the Discovery TV Channel spent nine hours interviewing Mr. Adams (founder of Raytheon) and himself on the first microwave oven. This will be boiled down to 15 minutes which probably will be shown on the Discovery Channel in February 1997.

My roommate at Tech, **Jerry Ansel**, responds that his health is good, he is widowed and looking. He has three children, ten



Walt Hoffman, '34, at the controls of his trusty Honda outboard, tooling down the Caloosahatchee River into the Fort Meyers municipal harbor.

ClassNotes



Jerry Ansel

grandchildren, and five great-grandchildren. He writes: "I swim three times a week. What took me 30 minutes two years ago, today takes 50 minutes. I walk two or three miles a day outside and in the mall when it rains or snows. I am still working as a first-grade teacher's aide two mornings a week. One of my rewards is when a boy comes up to me, hugs me, and says, 'I like you.' Have also been working with first-year vocational high school students on a reading program. I have been planning to visit Texas in July, to visit friends and to poke around. I had planned to visit **Ted Kresser.**" (Note: Ted died several months ago.)

A response and a picture from **Po T Ip** from Vancouver where he is still working as a financier for an apartment building and leasing operation. His health is good, but his wife does have some problems. Gardening is his hobby, and he uses yoga as a regular form of exercise. His favorite reading is *Health Letters*. . . . **Paul Levitan** writes from California that he is still working but almost retired. He is in good health, as is his wife. Besides his practice, his principal hobby is agriculture, and he is an active gardener. He reads constantly, and, no surprise, his favorite subjects are medicine and agriculture. . . . **Doug MacMillan** writes from Cape Cod that his health is poor as he suffers with Parkinson's. His wife is fine, and they have two children and four grandchildren. He has traveled to Maine and Canada and reads occasionally.



Po T'Ip



Doug MacMillan

As I started to close this column, I received three items of bad news. **John Hrones** learned via **Kingman Crosby** that **Francis Jenkins** died in May 1996 of a massive heart attack. John writes, "Anne (Mrs. Jenkins) wrote that the week before, he played tennis and that two weeks prior to his death they had returned from Paris, the Chunnel, and London. Fran and I became good friends in our freshman year. He was best man at Margaret's and my wedding and I was best man at Anne's and his wedding. King Crosby and Charlotte were in Cambridge early in June for Charlotte's 60th Reunion at Radcliffe (Harvard) where they met my daughter Janet and husband John Roach."

Francis was a retired VP of the Sprague Electric Co. in North Adams where he was employed from 1951 to 1973. In 1993 he moved to Cotuit. During WWII, he was in active service at the Watertown Arsenal and then served with the Reserves, retiring as a lieutenant colonel. He is survived by his wife, Anne, a daughter, two sons, a sister, and seven grandchildren.

Larry Stein, who has been busy repairing winter's ravage of his attached greenhouse, called to say that he was advised by **Paul Wing** of the recent death of **John Hawkins**. . . . **Walt McKay** wrote that he learned from **Joe Bicknell**'s daughter that Joe died July 22 shortly after suffering a stroke. He was a former faculty member at MIT. I hope to have further details on both men in next month's *Review*.

We have been refurbishing our old garage and converting our garden of annuals to perennials. I have not had too much time for sailing. Now July, I realize that when you read this, you will be preparing to celebrate Thanksgiving and the year-end holidays. I want to send the greetings of the class for a wonderful set of celebrations for all the holidays, and to wish you a healthy, happy New Year!—**Carl H. Wilson**, secretary, 48 Druid Hill Rd., Newton Highlands, MA 02161-2023, tel. and fax: (617) 527-7088; e-mail: <carl.wilson@mci2000.com>; in December: 1820 Avenida del Mundo #309, Coronado, CA 92118-3014; tel. and fax: (619) 435-3712; same e-mail

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Zay B. Curtis, Jr., passed away in Ponte Vedra Beach, Fla., on March 18, 1996, after an eight-year struggle with Alzheimer's disease. A Course IX student, he was editor-in-chief of the *Tech Engineering News* during his senior year. Most of his active life had been spent in Summit, N.J., where he was president of Zacon, Inc., a sales and engineering firm. Zay and his wife, Betty, moved to Florida after his retirement in 1980. In addition to his widow, he is survived by one son, three granddaughters, and one great-grandson. . . . In last month's memoir on **Prescott Smith**, we omitted to mention that his father, Robert H. Smith, had also been a member of the mechanical engineering faculty at the Institute from 1882 until his retirement in 1932. Thus father and son, both of whom ran the Machine Tool Laboratory, now called the Materials Processing Center, served MIT for a total of 80 years. . . . The spring 1996 issue of *Daedalus*, the journal of the American Academy of Arts and Sciences, contains an autobiographical article by our ex-class president, **John F. Taplin**, "The Education of An Inventor," which includes his time at MIT in Course VI. His favorite teachers were Norbert Wiener and Ernst Guillemin.

Charles D. Hanley writes after a long silence: "I have been retired almost 20 years and living on the eastern shore of Maryland. It's not as cold as Maine nor as hot as Florida, and we have seasons. In August I will be 84 with no life-threatening ailments, but I have two disabilities that make life less than wonderful. First of all, I have become very deaf, which louses up your social life and is the reason I don't go to reunions. Secondly, an operation to remove fluid from the brain last year destroyed my balance mechanism, and I am condemned to using a walker. I have a son and a daughter by my first wife who died 35 years ago. My second wife and I celebrated our 30th last May. I have thoughts about our class and Course XIII and will write again."

Howard Mason writes, "While I was still an MS student at MIT, I spent a year in Havana teaching chemistry from fourth grade to high school at the Collegio Ruston. Back in the U.S., I finished my PhD, took two years at Harvard, then a position at the National Institutes of Health in Bethesda, where I spent the war working in various aspects of war gases. When the war ended, I stayed at NIH but shifted to the biochemistry of oxygen for my academic lifetime." He now does research at the Univ. of Oregon Medical School in Portland, and has written more than 200 papers and reviews in his field. In 1952, Howard married Margaret Morris, who was from Cambridge, England. Of her, he writes, "Margaret was a gifted plantswoman, mother, and mountain climber, who died of colon cancer in Portland in 1995. I haven't recovered from her death. She was beloved by her daughters and grandchildren, and by many Portland friends."

Attendees at the 1996 Technology Day events included Nathalie and **Thonet**



A Course VII Class of '35 mini-reunion in Canton, Mass., last June, included (from left) Phoenix Dangel, George Reese, and Bernard Berger. The photo was taken by Course I alumnus Paul Berger, '50.

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Dauphine, Ida and **Macklen Kleiman**, Barbara Terwilliger, and Joyce and **Art Cohen**. . . . Send news for this column to either of the following: **Thonet Dauphine**, president, 57 Alcott St., Acton, MA 01720-5540; tel: (508) 263-3494; **Walter H. Stockmayer**, acting secretary, Department of Chemistry, Dartmouth College, Hanover, NH 03755-3564; tel: (603) 646-2503; fax: (603) 646-3946; e-mail: <walter.stockmayer@dartmouth.edu>

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In late May, on the trip East in the VW camper from Santa Fe to New Jersey, I stopped to see Bernice and **Bob Van Patten-Steiger** (Course XV). They were preparing to move but welcomed me and provided a night's R&R—a relief from the monotony. (Coming on to a second ankle operation, Phoebe had flown.) A week or so after reunion, Bob sent his new address: 954 Oakwood Ln., Myrtle Beach, SC 29572-5770. He inquired about **Francis Danforth** (XV), having spotted his name in the reunion directory. Long ago they were members of the same church in Newtown, Conn., but never realized the classmate connection.

Walt MacAdam fulfilled his reunion promise of an item for the Notes. His book, *Beyond the Bozeman Trail*, an authentic brief history (182 pages) was recently published. His great-grandfather was severely wounded early in the Civil War but recovered to continue in active service through the Wild West until 1881, keeping a diary that Walt found in 1963. His preface, maps, and illustrations compel one to read the book and offer new insight into that period in history. Call him at (603) 643-2278. . . . **Harry Essley** has loaned me two audio cassettes that he and Betsy recorded during 1970-71 on the hospital ship S.S. *Hope*. More on this in another issue. In 25 years of retirement, they have enjoyed a wide variety of activities, including white-water rafting, sailboat rafting, canyonlands hiking, Western and Swiss skiing, exploration, and swimming with elephant seals—in locations like Greece, the Australian outback, Yucatan, Galapagos Islands, and Siberia.

One of the reunion cancellations was Dinny and **Slim Beckwith**, who had returned home a week earlier with a flu from a business convention of 1,700 people. Many of them also caught it. It wasn't deadly, but debilitating and untreatable—they just had to wait it out. . . . Also, **Ro Ortynsky** was stricken with atrial fibrillation late in May and spent hospital time with round-the-clock treatment to quiet a very rapid pulse. Subsequent chemotherapy was preparing him for defibrillation treatment in August, but he gladly accepted appointment as assistant secretary. . . . And on the weekend before reunion, **Towers Doggett**'s wife, Doris, tripped on a staircase, broke her right collarbone, and sustained a serious blow on her head. A concussion, then fluid build-up and cranium operation ensued, with two weeks in the hospital. All is well two months later, and they are planning another trip to England—this time with a daughter and two grandchildren to see their grandmother's roots.

A note from **Ollie Angevine** tells of **Tom Terry**'s being in rehabilitation in June, following a knee replacement in March. Tom reports that he is walking again, a bit stiffly, but with no pain, and able to drive. He now has a housekeeper and, in one week, gained six pounds! . . . In May, **Dorian Shainin** was made an honorary member of the American Society for Quality Control, reserved for those "who are clearly preeminent in the profession." The citation continues, "A pioneer who created down-to-earth problem-solving strategies, Shainin's contributions over 60 years have had a lasting influence around the world in health care and many industries, and notably in the Apollo space program." A founder of the society, he was named a Fellow in 1949, served as VP in the '50s and '70s and watched it grow to 130,000 members. Also, he was elected an academician of the International Academy of Quality.

A first-time-since 25th reunionee was **Mal Graves** (XV), who with wife, Florence, brought daughter, Sharon. He had already sent a note to the Alumni/ae Fund: "I left my administrative job at the Lynchburg, Va., Peace Education Center but am still on the board of directors." They are planning to move closer to family and grandchildren in Southern California. His active career was in systems management with AMF in Buffalo and American Standard in New York City. After an MA at Fairfield University, he taught business management at Central Virginia Community College. . . . Dividing their time between Wellesley and Tech, Edith and **Edson Snow** (XV) attended both 60th reunions, including the Cardinal and Gray dinner, POPS, and the reception afterwards. Ed knew the family of Pops conductor Robert Bernhardt during his years with Eastman Kodak in Rochester, and Ed attended Bob's bar mitzvah. Bernhardt led a rousing POPS performance—geared to MIT and with good humor interspersed.

Ken Winsor's oarswoman statue is a gift to the class and to the Institute from Ken and his wife, Traute. Entitled, *Nausica, Goddess of Rowers*, and cast in bronze, it was a sizable outlay, not to mention the value of his beautiful artistry. (See *Technology Review*, October 1996, p. MIT17.) Many, many thanks, Ken and Traute. Arrangements are being made for Friends of MIT Crew to provide an appropriate base and plaque. . . . The *Boston Globe* must be well read over a wide area. Enough copies of the reunion crew picture have come in the mails for every grandchild, with some extras, from classmates, Tech staff members, and friends. . . . **Pete Weinert** will be happy to mail to any readers copies of the illustrated magazine article on their building a birch bark canoe—write to 950 Fairway Circle #D, Barrington, IL 60010-3802.

To all classmates, wives, and widows: Holiday greetings from your class secretaries, and please add **Roman Ortynsky** or me to your card list—with a note of something to record in Class Notes during 1997 and any address changes.—**Frank L. Phillips**, secretary, Van Beuren Rd., Morristown, NJ 07960; tel: (201) 267-0299; **Roman L. Ortynsky**, assistant secretary, 100 Pinegate Rd., Peachtree City, GA 30269; tel: (770) 487-6704

37 60th Reunion

If you would like to receive a 60th Reunion music tape, whether or not you attend the

reunion, listen up. **Pete Reitz**, our indefatigable music master, wants to make us all one, but has run out of ideas as to what to include. For our 50th and 55th, Pete used up about all of his recordings of the '34 to '37 era. Now he needs our suggestions. Pre '34 songs? Post '37? Collection of best sellers over the years? He has plenty to choose from, for he has about 10,000 78 RPMs, LPs, and cassettes. Write to one of your secretaries or directly to Pete at 700 Mexico Place, Palos Verdes Est., CA 90274. But hurry!

From Stanford, Calif., comes the sad word from **Dave Tuttle** that his wife died earlier this year. He misses her especially in their garden, where she excelled. Dave spends time with his MacIntosh, "fusses with differential equations," and finds time to swim every day. He usually returns to Amherst (where he received his undergraduate degree) every June and is planning to attend our 60th next June. . . . Your co-secretary had an overdue reunion recently with two classmates—**Irwin Sagalyn** and **Albert Shulman**—and our three wives at a luncheon in Sturbridge, Mass., a kind of halfway drive for each of us (Northampton, Hartford, and Lexington). The three of us were very close at Tech and have managed to stay in touch over the years. What a blessing! Both of them are still actively involved in their businesses and plan to stay so.

Walt Wojtczak hastens to explain the use of his expression "second generation grandsons," which we questioned in these Notes a while back. The first generation, he says, is Chris and Andrew, college grad and college sophomore, respectively. The second generation is the two sons, ages 4 and 2, from the second marriage of Walt's son, Rick. Walt is planning on attending our 60th. See you there with **Bob Thorson**, who recovered during the summer from a not-so-good winter. His wife, Rose, is also on the mend. During the Olympics, Bob observed: "I believe that the oars used by Olympic crews were concept oars designed by classmate **Philip Dreissigacker**, who died in 1994. . . . Speaking of rowing, **Joe Smedile** sent us a fascinating article on the sport from the *Smithsonian*. Want a copy?

Norm Birch and wife Elvie are very pleased with their home in Lakeland, Fla., where they have lived for the past dozen years. Norm says, "Lakeland excels in the qualities deemed most important in '96: a healthy employment market and strong prospects for future growth." Norm goes on to reminisce about earlier times: "Since Elvie's parents and mine were Finnish immigrants who met and married in the early 1900s, we both learned to speak, read, and write Finnish, and will soon be attending the annual "Finn Fest" in Marquette, Mich." Norm and Elvie will be coming north for our 60th.

Two years ago, the Class of 1937 Scholarship was awarded to a freshman named Timothy Macinta? He finished his junior year last summer and has written a thank-you letter to **Phil Peters**. Some excerpts: "I am so grateful that generous people like you saw fit to give unselfishly so that the dreams of others could come true. . . . Before coming to MIT, I had lived on the poverty line for my entire life. . . . As a freshman, I was thrilled to get a job in a restaurant for minimum wage. . . . I was a computer science major and got my first big break last summer working for a startup company called Dimension X. . . . I am on the forefront of an emerging technology called java programming. . . . At the end of my junior year, I have received unsolicited job offers that carry salaries at the high end of the range for MIT graduates with a computer science degree. . . . I am working 14 hours a day on a book. . . . I am planning to start my own software company when I graduate in 1997."

We regret to report that **Willard Marcy** died in 1984. We have no details, but express our sympathies to his wife, Helen.—Co-secretaries: **Leonard A. Seder**, 1010 Waltham St., B-342, Lexington, MA 02173; **Robert H. Thorson**, 66 Swan Rd., Winchester, MA 01890

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Class President **Fred Kolb** sent a questionnaire to about 75 classmates who have either attended or voiced an interest in our mini-reunions. He requested responses to mini-reunion 1996 from those who attended, and what might get you to attend mini-reunion 1997 (tentatively scheduled for Friday-Saturday, June 6-7. If you did not get a questionnaire and have something to contribute, please write to either Fred or your class secretary. With the first 12 replies came some of the following items.

Don Severance thought it a very successful program—he and Phyl enjoyed it. . . . **Frank Gardner** writes, "E and I regretted missing '96 very much but I was finishing some radiation that has done its job. I feel great and we look forward to attending in '97."

Russ Rossano writes from Redmond, Wash., that he could not attend this past reunion since he and Margo were on an extended trip to Europe that included Barcelona, the island of Majorca, and Paris. They also enjoyed two weeks in a condominium at Cabo San Lucas, Baja California. In early September they plan to attend an Elderhostel seminar on pre-Renaissance art in Assisi, Italy, visiting his sisters and their families in New York on the way." Russ says, "Retirement has been just great. I continue to write, consult, and to teach introductory physics and earth sciences to 7, 8, 9, and 10-year-olds at Margo's Bellevue Montessori School. Margo has retired as owner-director of the school, and turned over the reins to our daughter Jeannine Hanson who is doing a great job as top administrator of this 300-pupil school."

From **John Garvin**: "Until my brain-stem stroke in 1994, I was very active—skiing in the United States, Europe, and Canada as well as New Zealand; and sailing the East Coast as well as the Leeward and the Windward Islands, the Bahamas, the Virgins, and anywhere else the wind blew. But since my stroke I cannot balance and I cannot swallow. As a result I move only with a walker and take all food through a tube directly into my stomach. However, I'm thankful to be alive and I have a friend who looks after me. I sold my 30-acre farm and bought this lovely bungalow where we live comfortably and will continue to take things easy."

Lew Hull writes that during March and April he enjoyed an interesting business trip to China and Japan. He and Miggie were in England in early June. . . . **Roy Hopgood** in his "suggestions for 1997" requests that we all do whatever we can to encourage our classmates'

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widows to attend our class activities.

If you should happen to see a white Buick with Virginia license plates MIT-38, your class secretary will probably be nearby!—**Paul R. Des Jardins**, secretary, 6251 Old Dominion Dr., Apt. 310, McLean, VA 22101-4807; tel: (703) 534-4813; **Frederick J. Kolb, Jr.**, president, 211 Oakridge Dr., Rochester, NY 14617-2511; tel: (716) 342-3093



Nine of these eleven '41 crew veterans took the new Charles S. Butt, Jr., shell out on the Charles River. Standing, l to r: Alexander Poskus, Erling Hustvedt, Chet Hasert, Bob Wilson Blake, George White, Edgar Hayes, & John Potter. Kneeling: David Howard, Robert Smith, Bob Wallace Blake, & Malcolm Abzug.

39

George Beesley and Eleanor write, "We went to some of the Technology Day functions and met up with **Bill Pulver** and Adie, **Joe Dana** and Jean, and **Ruth Pitt**. We all went to the Cardinal and Gray dinner (and a special thank you to Bob W. Blake, '41, for sending a photo of Joe Dana and Bill Pulver at that dinner) and sing-along at the Faculty Club Friday night. On Saturday, we went to the Tech Day program, "Miracle or Mirage—Technology at the Horizon," and the luncheon. Bill and Adie are going to Puget Sound, Wash., to visit their daughter and do some sailing. They thank all for the prayers for Bill's recovery. Joe and Jean are going on a university trip to Ireland. They skied Mammouth Mountain in California with their son. Joe has recovered nicely from a tennis injury. Eleanor and I went to two Elderhostel programs in Georgia this spring and we are planning to go on a Greek Island cruise in October." . . . **Otto Morningstar** took undergraduate studies elsewhere, but he earned a PhD in physics at MIT in 1939. He says, "MIT did a lot for me. " He retired as chairman of the board from Data Packaging Corp. . . . **Phil Bush** and Margie write, "As I've read '39er Class Notes for lo, these many years, I realize more than ever how lucky we all are. We finished school at the end of the Depression, survived WWII, and have worked/played during the very best of times, doing our extra bit for multiple good causes, and now we enjoy retirement during the most golden years in U.S. history."

George Cremer excelled as an undergraduate high-bar gymnast. I was watching Olympics gymnasts on TV and thinking about George when he telephoned. George asks '39er math experts to tell him who found (and when) the geometric formula by which pentagon and hexagon plates can be joined so their corners all fall on the surface of a perfect sphere. George says soccer ball segments are cut as hexagons and pentagons and then sewn together to make perfect spheres. That suggests **Joe Dana** might provide some enlightenment because he contributed some years of his career to a sports equipment manufacturer. Your secretary nominates Bill Pulver and **Bob Sackheim,** both of whom have solved puzzles published in Alan Gottlieb's "Puzzle Corner." All classmates are invited to write their theories and other comments to George Cremer, Box 155, Lemon Grove, CA 91946.

Charles Wang writes, "The first time I came to the U.S. was as a student in 1935. Travel across the Pacific was by boat, and it took 17 days. Travel across the U.S. was by train and took some days. In 1995, Julie and I visited with family in Shanghai to celebrate our Golden Wedding Anniversary, and that trip took less time! In 1935 and 1995, we visited Yellowstone Park. We found Shanghai is changed by high-rise buildings, many taxis, and much dust and pollution. Now we are glad to be back in California."

After 16 years of high-quality, dependable service, my computer and printer failed. Two days ago, replacement arrived: a Compaq Prolinea 5100 with a 100mhz Pentium processor, 16MB/1.8 gig hard drive and a HP Laserjet 5P printer. The new equipment works at an speed faster than I can think *or* type. My reorientation burden seems greater than that of a bike rider who is transported suddenly from a simple bicycle to a space shuttle.

Please send news for this column to: **Hal Seykota,** secretary, 2853 Claremont Dr., Tacoma, WA 98407-2332

40

Sam "Spec" Card sends results of the survey about the mini-reunion planned for January 1988 on Sanibel Island, Fla. It was sent to a limited number of members of each class from 1936 through 1963. Ninety-three or 25.8 percent of our class responded. Among these, 34 were "likely attendees," seven were "maybe," and 52 were "no." Of the total number of 2,886 people surveyed, 269 responded—104: "likely" and 49: "maybe." As more news of this event is available, I will keep you informed.

A letter today from class president **Bruce Duffet** mentions that he had letters from **Dick Babish, Walt Helmreich,** and Spec Card. Bruce says, "I returned last week from the New Mexico Senior Olympics. There were 1,600-plus Olympians competing in 40 different categories. It occurred at the same time as Atlanta—so warranted minimal publicity. Following in the path of **Bill Stern** and **Al Guttag,** although not in the footsteps, I competed and won the tennis doubles in the 75-79 Old Men category. The gold medal qualifies us for a spot in the National Senior Olympics in Tucson next May." (Too bad that they have to use the term "Old Men.")

From San Francisco, **Fred Noonan** writes, "I attended my 60th reunion at Boston Latin School a few months ago and was pleased to again have a visit with our MIT classmates **George Wolfe** and **Ralph Millet.** Needless to say, I am looking forward with great hope to our 60th at MIT, and learning how to write the year 2000."

Send those letters or make those telephone calls to **Richard E. Gladstone,** secretary, 250 Hammond Pond Pkwy., 1205S, Chestnut Hill, MA 02167; tel: (617) 969-5161

41

The Class of '41 assembled for our 55th Reunion at MIT on June 6, 1996. With the new MIT schedule combining graduation and reunion events in the same week, the Cardinal and Gray Dinner and the Pops Concert were set for that evening. Nancy and I met many classmates as we registered and trucked our stuff to our room in McCormick Hall. Attendance varied at events during the week from 28 classmates and 20 companions (pre-Pops

reception) to 40 classmates and 32 companions for the Friday class banquet. It was nice to see Mrs. **Carl L. Goodwin** and her three children at this event, as well as several local classmates. Meetings and reminiscences continued at the pre-Pops reception and Cardinal and Gray dinner. Events for all post 50th Reunion classes, which made it easy to see friends from other classes.

A very pleasant evening was spent at Pops." Each selection was made relevant with a humorous, engineering, or science-related introduction by the conductor Robert Bernhardt. Pamela Wood, a well-known soprano and lecturer in music at MIT, performed. Friday was graduation, a day for campus tours of such exotic areas as the Artificial Intelligence Laboratory, Media Lab, Center for Cancer Research, MIT Center for Genome Research, and Athena computing facilities. One group, organized by **Chet Hasert**, assembled at the Pierce Boat House to row the new **Charles S. Butt, Jr.** shell, contributed by class members and other MIT rowers. Charlie, a standout in the international rowing and coaching community, organized a similar rowing effort at our 50th, but died unexpectedly of leukemia the next year. Nine of the eleven (shown in the accompanying picture) rowed the shell bearing Charlie's name from Pierce Boat House to the old MIT Boat House near the Cottage Farm Bridge. Everyone met at the MIT Museum for a cocktail reception and the Class of 1941 Banquet.

After the Banquet, class president **Sepp Dietzgen** conducted elections for class officers. Present officers were reelected: president, **Sepp Dietzgen**; VPs, **Ed Marden, Mitch Marcus, Leona Zarsky**; class agent, **Will Mott**; secretary, **Charlie King**; and treasurer, **Ivor Collins.**

The class then enjoyed an illustrated talk by **Joe Gavin** on the Lunar Excursion Module (LEM), one of the most interesting and least understood pieces of hardware in the Apollo Program. This paper-thin spacecraft was the taxi for two astronauts, from lunar orbit to the lunar surface, their home there for up to three days, and their taxi back to meet the third crew member, waiting in the command module in lunar orbit. Joe was VP and program manager for the LEM at Grumman Aircraft.

A memorial service for deceased alumni was held Saturday morning at the MIT Chapel. Thirteen members of our class who died during the period April 3, 1995, to March 29, 1996, were remembered. Saturday was Technology Day with a morning program covering new developments in biology, materials and recycling, and communications and information technology. Our 55th Reunion class gift was $332,897, contributed by 57 percent of the class, and solicited under the leadership of gift chair, Joe Gavin.

Sunday morning 31 classmates and 24 companions headed for Woods Hole, Mass., to meet our genial guide, host, and classmate, **Sterling Ivison** to board the ferry for Martha's Vineyard for a two-day stay at the Harbor View Hotel or nearby Kelly House in Edgartown. Highlights were a New England clambake on the Harbor House lawn and a humorous, anecdotal introduction to the island from Sterling, a 70-year resident. On Monday, Sterling and his wife, Katherine, hosted a cocktail reception at their beautiful home overlooking the ocean near Oak Bluffs. We then enjoyed a gala dinner-dance at the Edgartown Room of the Harbor View Hotel. . . . **Sam Fry**, disappointed at having to sing "In Praise of MIT" at Pops, organized a quartet with **Rog Finch**, John Potter, and **Charlie King** to lead "The Stein Song," "Take Me Back to Tech," and other old favorites. Before winding up this nostalgic but lively evening, Sepp Dietzgen thanked all the organizers and contributors for the success of this unique 55th Reunion: Mitch Marcus, Ed Marden, Leona Zarsky, for their steady help; Joe Gavin for his successful gift fund drive and outstanding LEM talk; and Katherine and Sterling Ivison for their Martha's Vineyard arrangements and hospitality.

Don't forget our 60th in 2001. Plan ahead and come! Meanwhile keep those postcards and letters coming.—**Charles. H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD, 20817-4839; e-mail: <olspaceman@aol.com>

42 55th Reunion

I received a note from **Heinie Shaw** at Hermosa Beach, Calif., while he was recovering from the repair of two ruptured wrist tendons. While still ski racing, Heinie won a silver medal at Crested Butte last year but says his racing days are just about over. His summer travels will include Florida, Oregon, London, Aspen, and Connecticut. . . . Zelda and **Bernie Levere** visited Syria, Jordan, and Israel, seeing Damascus, Aleppo, and Amman among other stops. They are planning a Baltic cruise for the summer, and we await reports of that one. . . . **Lou Rosenblum** and **Bill Denhard** are hard at work setting up an outstanding class reunion scheduled for June 3-6, 1997, at the Doubletree Islander Hotel in Newport. Events will include a mansion tour, harbor cruise, a clambake, and other dinners at the hotel.

Two obits: **Dick Heldenfels** of Course XVI died at Newport News after a six-year bout with Alzheimer's disease, and **Ed Kaulbach** at Helotes, Tex. Dick was associated with NASA from 1947 until 1980, retiring from the Langley Research Center. He received NASA's Exceptional Service Medal in 1969 and the AIAA Structures and Materials Award in 1981. Our condolences to their families.

Any suggestions for reunion planning should be sent to Lou at: 24 Cedar Rd., Belmont, MA 02178.—**Ken Rosett**, secretary, Apt. 10, 2222 Americus Blvd. N., Clearwater, FL 34623

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I called **Chris Matthew** to get additional information about a *Tech Talk* article concerning him and picked up more than I had expected. After 11 years of continuous service on the MIT Corporation—10 years as an alumni term member and one year as Alumni/ae Association president—Chris has been elected a life member. He is also chairman of the board of directors for *Technology Review*. Recent travels took Chris and Marge to Cambridge for Technology Day, where they

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D.G. Larson, PhD '92
W.F. Lenz, NUE '77
C.A. Lindberg, '78
A.J. Ricciardelli, '78
M. Walbaum, SM '88

encountered **Jim McDonough** and **Jim Hoey**. They later spent some time at their place on Maui, and then on to Chicago to visit a brother and to attend the wedding of Joe Collins' son. For the benefit of all Course X grads, Chris revealed that Rosalind Williams, dean of undergraduate affairs at MIT, is the granddaughter of our great god, W.K. Lewis. ChEs visiting Cambridge are invited to call on her and pay their respects.

Paul Heilman, '44, has sent a lengthy report about **Barrett B. Russell III** (Course X), who lives in West Chester, Pa. Barry and Barbara spend their summers in a cottage located in South Dartmouth, Mass., on Buzzard's Bay. The place has been in the Russell family for several generations, and boasts many ancestral heirlooms. Because of his seniority, Barry has become known as the Squire of the Cowyard, as the locals call it, and he welcomes all new property owners with a personal letter. This area has many associations with MIT. Several faculty members have had cottages there, and the nearby Round Hill property was once owned by the Institute, which used it for conferences and research from the '30s to the '60s. Barry spent several years in Tulsa, working for Du Pont, and I was well acquainted with him through alumni/ae activities.

A news release from the International Executive Service Corps reports that **Benjamin D. (Dave) Halpern** returned last summer from another two-week volunteer mission, this time in Ballabgarh, India. In response to a request from a local chemical company, IESC sent Dave to advise on the improvement of the company's operations. As an expert in the fields of extraction and purification, he advised on the production of a new anti-cancer drug that uses extracts from plants indigenous to India. Dave is the retired president of Polyconics, Inc., and lives in Jenkintown, Pa.

It's been a great month—no obits!—**Bob Rorschach**, secretary, 4727 S. Lewis Pl., Tulsa, OK 74105-5138

44

Irving Salsberg was awarded the Distinguished Service Medal by the Boston Architectural Center in June 1996. . . . **Ed Roos**, class president, sends along some reminiscences of Tech Day in June. He signed up for an architectural tour of downtown Boston. It emphasized specifically those buildings designed and built by MIT graduates. Ed was particularly impressed with Post Office Square Park created on the site of a former garage and considers it a gem not to be missed by visitors. Nearby, the Rose Wharf Building, a mixed-use structure, developed by Norman Leventhal, '38, has a wonderful view of the harbor through its central arch. In attending the Cardinal and Gray Society dinner at the Faculty Club, Ed was surprised to find that he was the youngest person present. The sing-along of Tech songs brought back many happy memories. On Sunday, Ed made a walking tour of downtown Boston, the Esplanade, Commonwealth Avenue, and Beacon Street, enjoying the classic bay windows of the brick brownstone buildings of the Back Bay areas and the new addition to the Boston Public Library. Ed hopes that these reminiscences will stimulate more classmates to come to Cambridge in the future.

Maryiane Ely wrote to tell of the passing of her husband, **Paul F. Ely, Jr.**, on May 9, 1996, in Stuart, Fla., after a long battle with cancer. He is survived by Maryiane, a son, daughter, and five grandchildren. He was a past president of the MIT Club of the Palm Beaches.

Robert Rorschach, '43, sent word in last June about **Ernest T. Schoenwald** being confined to a nursing home in Tulsa, Okla., suffering from dementia and a heart attack. He passed away on July 29, 1996. Ernest was a graduate of Culver Summer Naval School in 1940. He received an SB degree in chemical engineering, an MBA from Harvard in 1947, and MS and PhD degrees in industrial engineering in 1973 from the University of Arkansas. He held executive positions in manufacturing companies in Cleveland, Ponca City, and Tulsa. He lectured at the University of Tulsa and Drury College and was an instructor at the University of Arkansas. His avocations were music, art, and swimming. He participated in masters competition swimming. There are no known relatives.

Bill Sadler and **John Lednicky** met together in July after cross-country airplane hops to the Napa Valley of California. Bill lives in Williamsburg, Va., and John in Lees Summit, Mo. The occasion was the gala festivities for the wedding of John's youngest daughter, Margaret, in quaint little St. Helena, with a reception at the Pegase Winery in Calistoga.

From time to time, classmates have asked how they can make a gift to MIT in memory of a departed classmate. There is a booklet and form that covers this and can be obtained from the Office of Memorial Gifts, MIT, Bldg. E38-202, 77 Mass. Ave., Cambridge, MA 02139-4307; tel: (617) 253-8059. The class extends its sympathy to the families of our departed classmates.—Co-secretaries: **Frank K. Chin**, 221 St. Paul St., Brookline, MA 02146; **Louis R. Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

45

William J. Meade, Jr., of Braintree, Mass., died of leukemia at Mass General on August 3, 1996. Classmate and V-12 roommate **Bill McKay** was with Bill at the time of his death. Bill spent all his working days at Stone and Webster's power generating division, retiring in 1989. You will recall that Bill served as class treasurer for many years. Class of '45ers attending Bill's wake or funeral were Bill McKay, **Tom McNamara, Bob Maglathlin, Frank Gallagher**, Carol and **Jim Pickel**, and Janice and **Dave Flood**, as well as yours truly.

A nice note from **Nick Mumford** wherein he indicates that he continues to work two days a week at the Episcopal Diocese in the Detroit area; he is their money man! Nick is particularly enjoying his e-mail correspondence with children and grandchildren—even a 5-year-old granddaughter (which suggests that even I should take it up!). His address is <nvsmjr@worldnet.att.net>. (All of you on the Net should forward your address to me or the Alumni/ae Office, as the next *Alumni/ae Register* will be including e-mail addresses, as will the class list that the Association provides me annually in the fall.) Nick and Carol will have completed the annual family visit to the West Coast by the time you receive these notes. For that matter, Fran and I will have long since returned from our September trip to the Grand Tetons, Yellowstone, Banff, Lake Louise, and Salt Lake City. I must confess that I—without Fran—had 10 great days of sail and revelry in the English Channel in July; not a drop of rain! . . . In late May a brief note from **John von Hemett**, in Louisa, Vir., advised that he and Toby are still savoring the 50th and look forward to an MIT Travel Program trip in October.

In mid-June Nancy Hoigne advised **Ray Grammer**, our class agent, that husband **Emilio Hoigne** died of a brain aneurysm on May 25. Those who attended our 50th will remember Nancy and Emilio bouncing about not only in remembrance of our 50th but also their 50th, as they met at MIT in July 1945. Nancy's address is 1515 Eastbrook Dr., Sarasota, FL 34231-3511. . . . **Vigdor W. Kavaler**, executive secretary of Rodef Shalom congregation in Pittsburgh, died January 17, 1996.

The July 1996 issue of *Soundings*, a boaters' bible, had a most interesting article about **Roger Hood** and his Gullguard Co., 15 Durfee Court, Somerset, Mass. All you sailors know what gulls can do to foul your vessel—and leave it to Roger, a Course XIIIer, to develop a solution. Roger was awarded his 10th patent for a "seabird deterrent system." How's that for a fancy title for a system of dacron lines and aluminum posts that keep adorable gulls and cormorants away from your boat or USCG solar powered navigational aids! Boaters, Roger has a deal for you; write him.

Fran and I wish you and yours the happiest of holiday seasons. See you next year!—**Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

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Please send news for this column to: **Edwin H. Tebbitts**, secretary, 9 Jerusalem Road Dr., Cohasset, MA 02025

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50th Reunion

Bob Kincheloe is still keeping busy in retirement. He's professor emeritus of electrical engineering at Stanford University and is active in several organizations: president of the board of trustees of Winslow Co-housing Group, secretary of the board of the Context Institute, and also serves on the Housing Resource Board (low-income housing). Bob lives on Bainbridge Island, Wash. . . . **David Yablong** reports from Wilmette, Ill., that he and his wife continue actively traveling. They've been to Antarctica and Argentina and are now planning another trip to South America. David remains active in the MIT Club of Chicago. His family now includes 10 grandchildren.

Dear readers, we need your help! We've had

virtually no input from classmates in the last few months—which means we have nothing to write about! How about some newsy letters?

Don't forget next June in Cambridge: our 50th Reunion!—**R.E. (Bob) McBride,** secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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Ed Kosower continues as professor of biophysical organic chemistry at Tel-Aviv University in Israel. He was awarded one of Israel's highest prizes in science, the1996 Rothschild Prize in Chemistry, in a ceremony at the Israeli parliament. He was a pioneer in the application of physical organic chemistry to biochemical problems. He is co-author of the best introductory organic chemistry text and wrote 60 articles in collaboration with his wife, Nechama Sternschuss, an MD. She used one of Ed's discoveries as a flourescence labeling agent for cells, and the technique is now used around the world. Besides the articles with his wife, Ed published another 200 articles and a total of four books.



Ed Kosower

Fred Furland died in May. He was a loyal alumnus who served as president of the MIT Club of Southern California before he moved to San Diego. On behalf of our classmates, I extend our sympathy to Fred's wife and the family.—**Marty Billett,** secretary, 16 Greenwood Ave., Barrington, RI 02806; tel: (401) 245-8963

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Our nautical friends, Dot and **Jim Christopher** write from an uncharted location off the coast of Maine that their sailboat, the *Nevahsink*, is becalmed and shrouded in thick fog. Ocean smooth as glass, visibility six feet, pin-drop quiet, very relaxing. If the sun ever comes out and the wind picks up, they plan to return to Rockport, Mass., from whence they started.

Stuart Frank Svedeman died on December 25, 1995, according to a note from his wife, Anne. Regrettably, I have no further information.

Lengthy obituaries and reminiscences in New Hampshire papers pay tribute to **William Scheer Lewis,** 68, who died on November 10, 1995, after a brief illness. At the time of his death, Mr. Lewis was the co-owner, with his wife, Barbara, of the Chase House, a National Historical Landmark in Cornish, N.H. The house was being used by the Lewises as a bed and breakfast while being maintained in immaculate condition as a showplace of the area. For most of his career, Mr. Lewis was a vertical engineer having been associated with Payne Elevator Co. in Cambridge and Otis Elevator Co. in New York City. His work involved high-rise buildings around the world, the best-known being the Sears Tower in Chicago. He was listed in *Who's Who in Science and Engineering* and *Who's Who in the World*. Survivors include his wife, Barbara; two sons, a daughter, a stepson, and three grandchildren.

I am sure I speak for the class in extending our sympathies to both the Svedeman and Lewis families.—**Fletcher Eaton,** secretary, 42 Perry Dr., Needham, MA 02192; tel: (617) 449-1614

ClassNotes

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Honor compels me to confess two lapses in my October Class Notes. I erred when I identified **Jim Cooney, Freddie Mellin,** and **Milt Rand** as **Hank Sharp's** brother Dekes. Jim and Freddie are Hank's brother Delts, and Milt was ATO. I apologize to all Dekes, Delts, and ATOs. My only excuse is naivete. The other error was introduced at the editing stage. The last paragraph should have begun, "Hank continues" not "Freddie continues." Hank's entertaining the Lacrosse team deserves credit, not misinformation.

Our 50th Reunion seems a long time away, but there are two reasons for attention. Our Class was quite a bit bigger than earlier classes ("the first big one," the Alumni/ae Office calls us), and more of us attend reunions than most earlier classes. Since the 50th is a major reunion, there are not many resorts that can handle the expected turnout for the off-campus portion. Your reunion committee has started the search, and our next meeting is November 20. If you have a suggestion or are able to attend, call Susan or **Mal Green** at (508) 358-1145.

In July, the *Wall Street Journal* reported that **Sam Raymond** had found someone to serve as president and CEO of Benthos, Inc., a position Sam had been filling since June 1995. Sam remains as chairman. . . .When **Nat Cook** retired from the MIT faculty in 1985 and moved to Eastham on Cape Cod, he did not forget all the technology he had learned. When his wife, Collie, president of the Eastham Historical Society, won a grant to inventory the historical houses in town, the Society



Class of '50 members attending the 1996 Technology Day: from left, Sam Raymond, Mal Green, Lindsay Russell, Bob Snedeker, Frank Winiarski, Frank Ferrigno, Karl Ahlstrand, Joan Ahlstrand, and Ita Winiarski.

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gained an unwieldy mass of data. Nate, quoted in *The Cape Codder,* said, "There are lots of programs for genealogy, but I've never seen one for old houses." He filled the void with a program, now available at the library, that contains deeds, pictures, plans, and genealogy. One listing, the Old Collins House, is Collie's family homestead from 1666. . . . Earlier this year **Walter Attridge** won election as a selectman in Dover, Mass. He campaigned on a platform of lower taxes.

Our class cybersecretary, **Lindsay Russell,** has moved our home page on the Web to a more efficient address. The new URL is <http://www.tiac.net/users/lindsayr/mit1950.html>. By 12 years, we are the most senior class to have our own home page. Thanks to Lindsay, as we shuffle into "geezerhood," we are managing to stay *au courant.*

This issue's sad news concerns **William Price** who died in January. Bill had lived in Logo Vista, Tex., and is survived by his wife, Pauline. . . . My last item is courtesy of my West Coast source, Hank Sharp. Hank wrote that his brother Delt, **Jim Cooney**, after a long struggle with severe asthma, died in his sleep on July 4 at his home in Portland, Maine. Jim served in the Merchant Marine during WWII. He conducted a successful CPA practice in Falmouth for many years. Jim is survived by his wife, Ginny.

Please send news for this column to: **Robert A. Snedeker**, secretary, Seven Mashie Way, North Reading, MA 01864; tel: (508) 664-1738; e-mail: <103244.1541@compuserve.com>

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Remaining very active in her architectural practice, **Maria A. Bentel** wrote us of the extensive family and MIT influence that characterizes her firm. In addition to her original partner and spouse, Frederick R. Bentel, FIAA, are her architect sons, Paul L. Bentel, PhD '93, and Peter A. Bentel, PhD candidate at MIT, as well as architect daughter-in-law, Carol Rusche Bentel, PhD candidate at MIT. Among their recent notable commissions are the Gramercy Tavern in New York City and Holy Cross Church, which received a 1996 AIA/IFRAA National Honor Award. Maria and Frederick continue as professors of architecture at New York Institute of Technology. Son Paul is a professor of architecture at Columbia University, and son Peter travels around the globe lecturing for the U.S. Government on the merits of our national hardwoods. Daughter Elizabeth, the only non-architect, is a lawyer and business person and is presently working in London. . . . For the last 15 years after retiring from the U.S. Navy (as captain) and IBM after 31 years, **Carl Liswith** feels that he is living in the lap of luxury in Clearwater, Fla. His golfing buddies refer to him as a triple dipper. His wife, Marian, continues to support him by working as a psychotherapist. They are the proud grandparents of three girls and one boy.

Sadly, we received the news of the passing of **Cornelis van Monk** on August 16, 1995. We extend our condolences to his wife, Edith.

Please send news for this column to: **Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368; e-mail: <greenfld@tiac.net>

52 45th Reunion

Invitations for our 45th Reunion have brought reunion chairman **Stan Sydney** some saddening responses. Mail to **Herman Knierman, Jr.** and **Floyd Kiernan** was returned marked "Deceased," with no further information. . . . Florence Uhler, the wife of **Ted Uhler**, wrote to say that Ted died October 29, 1995. He was diabetic and had been quite ill for some time. . . . **George Jordan**, whom you may better remember as George Zavelakis, died last April 20. His wife, Connie, notes that his death occurred in his prime, with a successful business, a new grandson, and an ongoing bonding with his son in his business, Dupaco, in Oceanside, Calif., where George was president. The Jordans kept their residence in Fairfield, Conn. . . . Stan also sent along the unhappy news that **Ben Agusta**, who retired from a 35-year career with IBM in 1991, died of colon cancer October 30, 1994. Ben was not tall but was very strong. I recall the story of an incident at ROTC summer camp when a big, tall cadet with unpleasant manners made the mistake of getting belligerent with Ben, who knocked him flat with one punch. Everyone loved it.

Stan's pleasant news. . . . **Bob King** is retiring and moving to Boynton Beach, Fla., to be near his son. . . . And **Jere Sanborn** wrote Stan that he would be unable to attend the reunion because of plans to tour Sicily and southern Italy around that time. Jere recently visited Kenya, and intended to visit Mt. Rushmore, the Tetons, and Yellowstone before heading to Italy. He says he is penciling in our 50th.

MIT Provost Joel Moses sent class president **Bob Lurie** a summary report on the Class of 1952 Educational Initiatives Fund, established at our 40th Reunion to strengthen K-12 education. Over $200,000 in gifts and pledges from 153 classmates is being used to aid two programs. The first is the MIT/Wellesley Undergraduate Teacher Education Program, which prepares undergraduates for Massachusetts state certification in math and science at middle and high school levels. Support from the '52 Fund covers part of the salaries of two professors, who are therefore able to devote much of their time to developing the program. Thirty-two students were enrolled in it last year. The '52 Fund also supports the MIT Teacher Fellows Program. It supports the stipends of several teachers who attend MIT on sabbatical to help design and teach the certification program described above. In his reply to Dr. Moses, Bob noted how important it is to know that the class's contributions were used so well in these very worthwhile education programs.

Please send news for this column to: **Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301; e-mail: <mit1952@mitvma.mit.edu>

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We have learned that **Tom Faulhaber** has designed and maintains a Web site for smaller businesses and enterprises, however, we have no other information on Tom. The Institute database reports only that he

was a member of Delta Upsilon and in Course XVII. The URL for his Web site is <http://www.businessforum.com>. Tom, please let us hear from you. . . . **Mark Schupack** has become professor emeritus at Brown University after teaching there for 37 years. He plans to expand his two main hobbies, photography and model railroading. Mark uses a 4x5 view camera, processes his own film, and makes his own prints. Mark was involved in model railroading 40 years ago at Tech and has now started building his own layout at home. He is also involved with the Tech Model Railroad Club and is writing an account of its 50-year history. The club is moving from its location in Building 20, which is being torn down, to Building N52. In May, the Club held its last open house in the Building 20 location, and classmates **Duane York, Dick Salter,** and **Jack Dennis** were there. Duane, Dick, and Jack: Please let me hear from you. Mark says that one of his friends, who had been retired for five years, was asked what he was doing. His response: "Nothing, and I am two weeks behind in doing it!"

This is your column. Please write to me and tell me what is happening in your life. Use the mail, phone, or e-mail. —**Joseph M. Cahn,** secretary, 20 Ocean Park Blvd., Unit #9, Santa Monica, CA, 90405; tel: (310) 396-6322; e-mail: < jmc20@aol.com>

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John McGann, our class agent, forwards some news that he picked up in the course of his work in behalf of MIT. . . . **Dan McNally** has retired from his position at Purdue University because of physical problems. We certainly wish him improved health now that he is taking it easier. . . . **Genevieve Ubel,** who retired from 3M Corp. some time ago, reports that she now has four grandchildren, and is looking forward to our 1999 reunion.

I have done a survey of these columns from October 1984 (just after our 30th Reunion) through this issue. During this period, 174 different members of the class have been mentioned at least once. That's about 24 percent of the folks in our official class list. Not surprisingly, **Bob Warshawer**'s name has appeared most often—18 times. **George Schwenk** is next with 14 citations, **Dick Morely** has 11, and **Paul Gray** has 10. Sixty-four others have been mentioned at least twice. It's a shame that we don't hear about or from the 538 who have not been mentioned at all. If you are in that group, please drop me a note. . . . Happy Holidays!—**Edwin G. Eigel, Jr.,** secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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While it is old news now, we all would like to congratulate **DuWayne Peterson** on his election as president of the Alumni/ae Association. We hope he has a productive and fun year, and wish him well in his latest undertaking on behalf of MIT.

Those of you who can access a copy of *RLE Currents,* published by the Research Laboratory for Electronics, should check out the Spring 1996 edition. It has a great article on **Dennis Shapiro.** Denny worked at RLE as he pursued his master's degree, and is one of ten interviews included in the spring issue.

Notes from all of you have been lacking of late—that is very dangerous and can lead to excessive reporting of the doings of your co-secretaries. However, suffice for this time to report that Georgia and **Jim Eacker** celebrated their 40th wedding anniversary by taking a tour of the Canadian Rockies, Vancouver, and Victoria—spectacular. Now where is the news from the rest of you?—Co-secretaries: **James H. Eacker,** 3619 Folly Quarter Rd., Ellicott City, MD 21042; **Roy M. Salzman,** P.O. Box 197, Rockport, ME 04856-0197

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Kreon Cyros is retiring from Draper Labs and MIT after more than 34 years. He will become president of a spinoff nonprofit company, OFMS, Inc. With a license from MIT for all the previously developed facilities-management systems, OFMS, Inc., will continue sharing its products and services with other universities, medical centers, government agencies, and corporations, as well as MIT. . . . **Rolf Wetzell** had his book, *Chess Master at Any Age,* published by Thinkers' Press (Davenport) in 1994.

Lawrence Hallee passed away on August 18, 1994, during a business trip to Bangkok, Thailand. He was a VP and director of Stone & Webster Corp. and executive VP of Stone & Webster Technology Corp. He was acknowledged as a world leader in olefins technology and was co-author of 20 articles on various aspects of ethylene production and purification.

Please send news for this column to: **Ralph A. Kohl,** co-secretary, 54 Bound Brook Rd., Newton, MA 02161

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40th Reunion

Please send news for this column to: **John Christian,** secretary, 23 Fredana Rd., Waban, MA 02168; tel: (617) 969-2741

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In 1985 **Charles Diebold III** died in a boating accident while on a fishing trip in Ontario. Recently his parents, Charles R. and Mary K. Diebold, announced a $1 million donation to MIT in his memory. The gift will establish both the Charles Diebold III Memorial Scholarship Fund and the Charles Diebold III Student Lounge in the recently completed Jack C. Tang Center for Management Education at the Sloan School of Management. They were quoted in the May 12, 1996, *Buffalo* (NY) *News*:"Our son, Charles, spent some of his most interesting days at MIT, so it seemed the appropriate place for a gift in his memory." A graduate of Course XV, Charles was awarded the Bronze Beaver in 1967. At the time, he was the youngest alumnus to receive this award, the highest honor from the MIT Alumni /ae Association.

News from the cruise—more details about classmates who sailed the Charles on our

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mini-reunion. **Joel Shulman** is retired and keeps busy playing poker and managing his portfolio (two separate activities, we assume!). He is working on improving his Spanish while also learning Italian and French. He and wife Ceres reside in New York City where they attend various cultural events when they are not indulging their other interest, travel. Joel noted that they keep in touch with other classmates, including a day spent in Atlantic City with Sonia and **Terry Sheehan** a short time before the reunion. Next on their social schedule were plans to attend the wedding of **Leonard Eng**'s son. . . . Bobbi and **Fred Fisher** enjoyed Memorial Day weekend with Helen and **Gus Fleischer** in Connecticut. They also keep in touch with Linda and **Marv Katz** who live in Houston. Fred is in the construction business with his son Mark, who received a civil engineering degree from Carnegie Mellon. They do mostly retail and office build outs. Fred notes that his other son David earned an electrical engineering degree from Tufts. Both sons live in the Boston area, giving Fred and Bobbi lots of opportunity to spend time with Mark's two children. Every winter they spend two or three weeks in Aruba.

During the mini-reunion cruise, **Bob Logcher** informed us that he was retiring after 34 years on the MIT faculty. He will continue to do some teaching at MIT, in Santiago, Chile, and elsewhere as well as some consulting and cruising in warmer climates on their sailboat. He and Chesley moved to Huckins Farm in Bedford last year and found themselves in the vicinity of classmate **Dave Rosen** and wife Krana, plus other MIT connected neighbors, John and Mary Kennedy, SM '75, and Course I Assistant Professor Shi-Chang and Young Wooh.

Lou Giordano is regional manager, Northeast, for Framtone Technologies. He has been working out of his home office in beautiful Quechee, Vt., since he and Maywood located there recently. He plans to retire from Framtone, formerly Babcock and Wilcox, at the end of 1996 after working there for the past 24 years. He notes that they had visited Karen and **Bob Schmidt** in Seattle enroute to visiting son Bob at UMontana. Just after the mini-reunion, Pat and **Dan Holland** stopped by their place in Quechee for a brief visit.

Our second missive from Cyberspace originated in South Africa from **Bob Baber**: "After receiving my doctorate in computing science from Techniche Hochschule Darmstadt Germany in 1995, I was appointed a visiting professor in the Computer Science Department at the University of the Witwatersrand in Johannesburg, South Africa, beginning in February 1996. This appointment has been extended for another year, so my wife, Ursula, and I will move from Germany into an apartment we have just bought in Johannesburg. After 32 years in Germany, we are looking forward to South Africa's warm, sunny climate and its wide open spaces. After some 20 years as a consultant in business on my own, I am looking forward to my new career in academia and to returning to university life." Bob concludes by noting, "The best way for classmates to contact me is by e-mail: <bob@cs.wits.ac.za> (at the university) or <100103.3216@compuserve.com> (at home). . . . **Fred Nadel** lives in a suburb of Buffalo, N.Y., and is celebrating his 20th anniversary year as owner of Fred S. Nadel & Associates, a business consulting firm specializing in business turnarounds and custom computer systems.

Please send your news to: **Gary Fallick**, secretary, 4 Diehl Rd., Lexington, MA 02173; e-mail: <fallick_gary@waters.com>

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Several communications from classmates relate their changing life situations. **Hayward Alker** reports his early retirement from 27 years teaching in MIT's Political Science Department, from which he moved to his first year as the John A. McCone Professor of International Relations at USC. He has been rewarded by an overdue sabbatical at the Santa Fe Institute. "It was a wonderful experience, like being a student at MIT again, but with tiny class sizes, equally brilliant teachers, and tenure to boot!" He also mentions completing two books, reflecting work at MIT and his Block Island summer home: *Rediscoveries and Reformulations: Humanistic Methodologies for International Studies* and *Challenging Boundaries: Global Flows, Territorial Identities*. Hayward ends his note, "It was wonderful to see **Manuel Blum**'s Turing award featured in *Technology Review*."

A letter from **Hal Laeger** says that he was "one of those oddball Techmen who migrated into advertising." After 32 years in advertising, the last 18 running his own small ad agency in Manhatten, he bought a tiny business involved in radiation badges. "We bought it for about the price of a used car, and set about making it grow." He reports that the results over the past five years have been more than satisfying, as Quantum Products has taken over his life. He adds that "this is the most fulfilling thing in my career; too bad it happened so late, but better late than never." One of Hal and spouse Barbara's two sons works with them, and they plan to turn Quantum over to them and begin "snowbirding in Sarasota" by the end of 1997.

As always, I urge you to provide an update to your classmates. It takes only a letter or e-mail to the address below.—**Dave Packer**, secretary, 31 The Great Road, Bedford, MA 01730; tel: (617) 275-4056; e-mail: <70421.1766@compuserve>

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We have very good news and heartfelt thanks from your class agent for your outstanding support of the Alumni/ae Fund for 1995-96. The Association has compiled the year-end totals, and they show that '60 has sent the Institute more than $654,000. Fantastic!

Robert Barrett sends e-mail from Messiah College, Messiah, Pa., where he is on the faculty. Bob's e-mail address is <barrett@mcis.messiah.edu>. His very interesting home page is <http://www.messiah.edu/hpages/facstaff/barrett/home.htm>. . . . **Sidney Altman** sends word that all is well at Yale and in New Haven. . . . **Morris Salame** sends a note telling me that the *Boston Globe* reported an interview with "a professor from the MIT Charm School." Morris is glad the Institute has added some class and is looking

for graduates with an SB in charmology or a PhD in charmanagement. . . . The American Jewish Congress reports that **Kenneth Myers** has been elected president of the Pennsylvania region. Ken is a partner in the law firm of Morgan, Lewis, and Bockius in Philadelphia where he heads the Philadelphia Environmental Practices Group. He is an active writer and speaker on environmental law, editor-in-chief of the *Environmental Spill Reporting Handbook,* and author of the Pennsylvania chapter of the *Environmental Law Practice Guide.* Ken recently participated in an American Jewish Congress mission to Israel, meeting then-Prime Minister Shimon Peres and Chairman Yassir Arafat. . . . **Barry Bronfin** writes that he and Cecile spent May sailing in the Abacos Islands and tasted the wines of Napa in June. Barry also enclosed a press release from his company, Financing for Science International, Inc., noting that in May FSI had signed an agreement whereby the company will be acquired by a subsidiary of the FINOVA Group, a commercial finance company. FSI leases equipment to corporations, research and development facilities, and health care providers.

From the University of Alabama in Tuscaloosa, **Dick Bradt** writes that for the '95-'96 academic year he was on the "Portuguese circuit." Dick presented invited lectures at the Portuguese Materials Society annual meeting in Aveiro, Portugal, and the Brazilian Ceramic Society in Criciuma. Dick currently is chairman of materials engineering at Alabama. . . . **Tim Hart** writes that the Harts are building a desert vacation getaway in Hurricane, Utah, the "Morman Riviera." Tim invites classmates to "drop in, er. . . land, and visit us at Sky Ranch (Grassy Meadows on the charts). F-22s welcome, Sheila." Tim says it's called Hurricane because some early visitor's hat was blown off. . . . Recently I received a phone call from **Tony Anastasion.** Tony says he took early retirement from AT&T in 1990 and is now living near his roots in Sutton, Mass. He is a single parent with two sons, who, Tony says, speak a language he doesn't understand! Tony also is a high school substitute teacher.

Please send news for this column to: **Frank A. Tapparo,** secretary and class agent, 15 S. Montague St., Arlington, VA 22204; e-mail: <ftapparo@lmi.org>

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Please send news for this column to: **Hank McCarl,** secretary, P.O. Box 352, Birmingham, AL 35201-0352; e-mail: <hmccarl@mail.business.uab.edu>

62 35th Reunion

Robert E. Anderson, president of Omniken, Inc., in Groton, Mass., has joined the board of directors of LAU Technologies, Inc., in Acton, Mass. LAU Technologies is a military and commercial electronic design and manufacturing company. **Joanna Lau,** chairman and president, was named the *INC.* magazine turnaround entrepreneur of the year in 1995. . . . **Peter W. Michel** e-mails that he is living in upstate New York and making a transition from architect to full-time sculptor. His piece, *Conversations in the Woods,* was recently shown at the Chesterwood Museum in the Berkshires. Peter is experimenting with computer controlled laser and waterjet cutting methods that allow the generation of multiple copies. Call, write, or e-mail for postcard images: (315) 853-8146, 36 Kellog Street, Clinton, NY 13323 or <jgm@mail.borg.com>. His wife, Jackie is a psychotherapist, consultant/coach, and workshop leader. His son, Greg, just graduated cum laude from Kenyon College in international relations, and his daughter, Karen Dunn, recently married her high school sweetheart and is working in Moscow.

Tom Burns <tgbu@chevron.com> has "volunteered" to chair our 35th Reunion Gift Committee. If you would like to join this committee, please let Tom or the Alumni/ae Office <rterri@mit.edu> hear from you. We would like to contact all of our classmates for the reunion and to rekindle their interest in the Institute. On a more personal note, Tom has two grown (and self-supporting) sons, and is still enjoying his work as general manager, executive staff, Chevron Overseas Petroleum. In his career, Tom has worked both domestically and internationally in all parts of this international petroleum business—refining, marketing, transportation, petrochemicals, corporate planning, and now, exploration and production. His wife, Louise, is executive VP of Hero Arts, Inc., a design graphics firm located in their hometown of Berkeley, Calif. Tom is looking forward to contacting all of our classmates during the coming year and to seeing all of us next June in Cambridge.

One sad note—I received a notice from the MIT Alumni/ae Office that **Ellwood Dennis Johnson** of Hartselle, Ala., passed away on April 1, 1996. If any classmates have further information please sent it to us.

Check our Web site at: <http://web.mit.edu/alum/www/Class/mit1962>. If you're tuned up on e-mail, please put a message through to: <mit1962@mitvma.mit.edu>. Alternatively, you can send a message directly to me at: <hmccarl@mail.business.uab.edu>. And you too, can get the unedited and unexpurgated class news while it is still fresh, hot off the Internet. Or fax news to: (205) 934-1318, or send your news and personal notes to: **Hank McCarl,** secretary, Box 352, Birmingham, AL 35201-0352

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Please send news for this column to: **Shoel M. Cohen,** secretary, Dept. of Psychology, Nassau Commnity College, Garden City, NY 11530; e-mail: <71271.2627@compuserve.com>

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Peter Cooperberg (Course VII) is a professor of radiology at the University of British Columbia. He can be reached at <cooperb@unixg.ubc.ca>.

Dick Posner (Course VI) has just left his position as VP for engineering at Whittaker Corp. to become VP for engineering at Powerwave Corp. The latter is a contender in the cellular and PCS basestation market and is especially successful in Asia. Dick expects the company will be going public

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R. Bradley Burdick, SM'95
Adolfo E. Canovi, SM'96
Alan K. Graham, '73

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soon. His son, Andy, is going into seventh grade and is excelling at tennis!—**Bill Ribich,** secretary, 18 Revere St., Lexington, MA 02173; tel: (617) 862-3617; e-mail: <mit1964@mitvma.mit.edu>

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Richard Gruen was recently named a utilities commissioner for Palo Alto Municipal Utilities. Richard says he's now able to follow the 80:20 law of work with consulting —he gets 80 percent of the pay with 20 percent of the work! More importantly, he gets to skip 80 percent of the useless meetings. This has allowed him to focus a lot of time on his *Bombay Clipper* sloop on San Francisco Bay. "I named my boat *Micro* so my assistant could say I was working on the Micro Ship." (ouch!) **Ed Hoffer** and wife Pam are approaching their 30th anniversary. He continues to work part-time at MGH, focusing on medical education software and diagnostic support while in full-time private practice of internal medicine and cardiology in Framingham. In response to the changes in our health care system, he joined four others to form a group and affiliated with Lahey Clinic. Ed competes at the master's level in bicycle racing and track and field and continues to enjoy life in general.

It seems the rest of the news centers on our children! **Chuck Seniawski** writes to say he's now essentially semi-retired and enjoying life in Cheyenne. His daughter, Barbara, just graduated from Dartmouth and has been in Amman, Jordan, for the last year on a Fulbright. His son, David, is a junior at Stanford in mechanical engineering. . . . **Ron Wilensky** is now VP for business development at TCI/BR in Sunnyvale. His older daughter, Slena, is a senior at Wellesley, and his younger daughter, Sabrina, is in middle school in Palo Alto. . . . In other news, **Dick Schwarz** reports that he has recently taken a new assignment with PPG in the Monroeville, Pa., plant, although he will continue to live in Akron until his daughter graduates from high school next year.

As for us, our grandson (and his parents) moved back to Seattle from Rapid City. Nothing against the Plains states, but visiting in Seattle's a whole lot easier. Please send news for this column to: **George McKinney,** secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167; tel: (617) 232-4710; e-mail: <georgemck@aol.com>

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Tom Hall spent his summer vacation getting 2,500 signatures on his petition to run for U.S. Congress in the 2nd district in Connecticut on the Natural Law Party ticket. The party takes a scientific approach to government. Tom lives in Coventry, Conn., but teaches electrical technology in Hartford at Capital Community Technical College. . . . We were visited in Buffalo by **Edwin Meyer** who was passing through on his way from a retreat in the wilderness of Canada to a festival in southwestern New York. Edwin is a contract programmer in Cambridge, most recently for Polaroid's digital driver's license software.

Please send news for this column to: **Eleanore Klepser,** secretary, 84 Northledge Dr., Snyder, NY 14226-4056; e-mail: <vismit66@ubvms.cc.buffalo.edu>

67 30th Reunion

By the time you read this, you should have received a questionnaire and letter from **John Rudy** regarding our 30th Reunion set for June 5-8, 1997. Please contact John <jprudy@swl.msd.ray.com> or me if you haven't. Do attend. . . . **Ray Giglio** visited the Sig Ep house last May while he was in Boston to attend a gas-cooling conference. He's a principal mechanical engineer with Central Maine Power in Augusta, Maine, and notes that deregulation has caused changes in his industry. . . . **Greg Zacharias** writes, "I'm still in Boston, still married to Susan, and still at Charles River Analytics. Life is good!" Their sons are 16 and 14, and the family is trying to cram lots of travel and vacations in before the boys leave home and become adults. "Teenagers are great!"

In April, the Seatrade Organization awarded Seaward International, Inc., its highest honor in the area of combating marine pollution. The award was accepted by **Frank March,** president of Seaward, a dinner in London attended by 450 guests from the international shipping industry. This "Oscar of Marine Industry" award was made for the Seaward-U.S. Navy project that recycled plastic waste from Navy ships into marine pilings. . . . I previously reported that **Joel Speare,** of Lexington, died of a cerebral aneurysm on April 22. He was 50 years old. He earned SB and SM degrees in aeronautics and astronautics from MIT and was a member of Phi Kappa Theta fraternity. He served on our 25th Reunion Committee and will be very much missed at our upcoming 30th, which he was looking forward to attending. Joel's first job after graduate school was at Aerospace Corp. in El Segundo, Calif. He joined Raytheon in 1972 and was most recently manager of the mechanical systems department. He was a principal and lead engineer in the design of the AEGIS and Patriot systems, as well as a major contributor to the Sparrow and Amraam programs. An avid and accomplished sailor, Joel was a longtime competitor and former president of the Rhodes-19 fleet in Marblehead. He was also an enthusiastic skier. Joel is survived by his wife of 28 years, Mary McCarthy Speare, two sons, his parents, and a sister.

Please send news for this column to: Sharlotte and **Jim Swanson,** co-secretaries, 878 Hoffman Terr., Los Altos, CA 94024; e-mail: <jswanson@earthlink.com>

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This is a first for the column! All the items this month were received by e-mail. All the submitters as well as anyone else who has ever submitted news by e-mail received the complete, unedited text of this column when it



William R. Brody, '65, SM '66 (VI), a 1991–96 member of the MIT Corporation, took office in September as the president of the Johns Hopkins University in Baltimore. Brody holds an MD degree and a PhD in electrical engineering from Stanford and is trained in cardiology and radiology. His most recent post was provost of the University of Minnesota Academic Health Center, where he was responsible for 5,000 students, 14,600 faculty and staff, and a combined budget of $750 million.

The chair of the Johns Hopkins search committee that nominated him said that Brody's commitment to issues of cost, quality, and access and his understanding of delivery systems and the application of technology were key factors in his selection. Brody has been a vocal and active advocate for radical change to resolve the financial problems of academic medical centers, and he believes the lessons learned there are important for all of higher education. Information about his appointment can be found at the Johns Hopkins Web site, <http://www.jhu.edu/news_info/brody>.

ClassNotes

was written, a few months before the publication date. We welcome use of this method to speed up class news.

Robin McGuire <mcguire@riskeng.com> writes, "I now have a renewed close connection to MIT: my oldest son, Chris, is entering as a freshman this fall. I am doing well, still running the consulting engineering company I founded 12 years ago. On a personal note, I started doing triathlons several years ago and this year have qualified for the Ironman Championship in Hawaii in October. This takes up most of my spare time but keeps me sane (or is it insane?)."

Dick Turner <philip.r.turner@jpl.nasa.gov> writes, "I'm still employed at the Jet Propulsion Laboratory working as spacecraft system engineer on a study of a 'Solar Probe' mission that would fly to within four solar radii of the sun. I've made five trips to Moscow since March 1995. Working with the Russians is quite interesting, and I've enjoyed the trips, met and worked with interesting people, and hope that we can work out some sort of cooperative arrangements in spite of the immense burden of working through our mutual bureaucracies.

"I have now been married for about a year. My wife works for a photo processing plant in Burbank that handles processing for the Savon/Osco drug stores. She doesn't plan to get into scuba diving with me but goes along on trips locally to 'watch bubbles.' We will be going on a trip to Fiji in October.

Hingloi Alfred Hung <alfred_hung@qmail4.nba.trw.com> writes that he is currently with TRW. He recently visited with **Robert Y. Li** and family before the International Microwave Symposium in San Francisco. They also had dinner with fellow classmate **Philip Jhin** and family. Bob and Philip are enjoying their lives in the Bay area. Alfred ran into **Mike Marcus** the following week at the symposium and also found that they have been almost neighbors for the past many years in Maryland. Alfred's children, Ingrid and John, are attending high schools in the Bethesda district. During the July 4th weekend, he and his family had a barbecue dinner in **Y.Y. Lau's** Maryland home. Y.Y. is currently a professor at U/Michigan. Alfred occasionally visited with other classmates, **Bertram Hui** and **Tang Lam.** Both are also living in the Washington, D.C., suburbs. . . . The daughter of **Sherman Hanna** <shanna@magnus.acs.ohio-state.edu>, Emily, will be entering MIT as a freshman this fall—she wants to study cognitive psychology and linguistics.

That's all we have this month. We look forward to hearing from *you*, whether it be by 19th-century or 20th-century media.—**Gail** and **Mike Marcus,** secretaries, 8026 Cypress Grove Ln., Cabin John. MD 20818; e-mail: <ghm@nrc.gov> or <mmarcus@fcc.gov>

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William P. Bengen, a fellow Course XVI man, writes: "I am now in my ninth year as a fee-only personal financial advisor and loving every minute of it. This is my third selection of vocation (preceded by aerospace engineering and soft drink bottling executive) and definitely my last. It has been hard work building a practice from scratch with virtually no advertising except word-of-mouth, but during the last 18 months business has exploded as my referral network reached 'critical mass.' I have also benefited from media attention (some national) focused on the research I have done on how to set up investments for retirement." He notes that his daughters are both approaching college age, but he is confident that he and his wife will find plenty of things to occupy their time. "We've both worked hard in developing my practice, so spending more time with one another in a nonbusiness setting seems appropriate. I'm taking up golf and am scoring consistently in the high 90s. Should anyone wish to get in touch with me, my e-mail address is: <billbengen@aol.com>."

Another aero/astro man, **David C. Hyland,** is now an aeronautics researcher, has been appointed chairman of the University of Michigan Department of Aerospace Engineering. He was formerly senior scientist at Harris Corp.'s Government Aerospace Systems Division in Melbourne, Fla. Dave's technical contributions include development of new methods for robust control design and analysis, co-invention of several new actuators, and invention in 1989 of a new neural network architecture for on-line system identification and adaptive control. He has served as principal investigator for numerous basic research programs for NASA and AFOSR, and was principal engineer for Harris's efforts on the Zenith Star Program. . . . Don Rosenfield, '71, who entered with our class, is pictured on page MIT35.

As these Notes are written, just retired MIT professor Keith Johnson is now filming his cold fusion movie, *Breaking Symmetry*, which will be distributed by a major Hollywood producer next summer. I had an advisory role in this. Please note my new address. Cheers!—**Eugene Mallove,** secretary, 1 Ridgewood Dr., Bow, NH 03304; e-mail: <76570.2270@compuserve.com>

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Thanks to the e-mail we received and to class Webmaster, **Bill Kindel,** we were able to scrape up some notes in mid August. . . . **Rick Tavan** writes that he finally made time to pursue a lifelong ambition of learning to fly and earned his private pilot certificate in June. Rick says, "The final push that got me to commit the time and effort was a desire to spend more weekends in Truckee (the Lake Tahoe area) where I have a vacation home. . . . Aerial tours of the Bay Area are a fun way to entertain friends and day trips up and down California are amusing.". . . **Tom Garrity** writes from Scottsdale, Ariz., that he is executive VP and CFO of PCS Health Systems, an information technology/health solutions company. He calls it the latest exciting opportunity he has enjoyed during his 18-year career with Eli Lilly and Co. He moved to PCS in the fall of 1994 after Lilly acquired it. Along the way, he earned an MBA at Chicago, led Lilly's European agricultural business for three years (from London), and pursued various marketing, finance, and strategy roles. Throughout, he has enjoyed the active support of his wife, Susan, and children, Steve and Laura.

Hilarie Orman has started a two-year stint as a program manager at the Defense Advanced Research Projects Agency (aka DARPA aka ARPA) working in the area of networks and network security. This requires her to live in Arlington, Va. It also required her to give up stewardship of the Ultimate Player's Association Web page; knee surgery to replace an ACL caused her to give up playing Ultimate for a year, but she plans to return. Her husband, Richard Schroeppel, '68, shares his cryptographic expertise with her, which helps with network security. And their daughter, Mercury Schroeppel, '94, "attempts to teach us the rudiments of investment banking when she drops in from Wall Street to see the old folks.". . . **Alan Chapman** reports that his song, "Everybody Wants to Be Sondheim," appears on *Broadway Bound: New Writers for the Musical Theatre*, a recent release on Varese Sarabande records. He has also been commissioned by the LA Opera to compose a children's opera for the 1997–98 season. He is writing words and music for *Les Moose: The Operatic Adventures of Rocky and Bullwinkle*. He invites classmates to visit with him at <http://www.oxy.edu/~chapman>.

Also from the West Coast, **Ron (Ronnie) Stoltz** writes that he continues to work for Sandia National Labs in San Francisco. Lately he has been managing a program in integrated design and manufacturing technologies that has a staff of 200. Although Sandia is a DOE national lab, Ron says they take most of their guidance from industry. The work is fun, he says, and enables him to interact both within his company and with universities, industry, and other labs. Ron's 19-year-old son, Mitch, decided to study technology at a liberal arts college, Pamona College, where he soon starts a second year. Ron's younger son, Greg, who is 17, spent a month in Germany this summer studying language and culture in a small town north of Frankfort. Susan (whom Ron met on a blind date in Boston after not seeing her for over 10 years following high school graduation) is moving to a new teaching job next year. She focuses on integrating science, math, and literature in the primary grades. As he wrote to us in August, they were leaving for a trip to the Ashland, Ore., Shakespeare Festival and a tour of Northern California and southern Oregon.

Greg and I have been watching Shakespeare in Central Park in New York City this summer. We also made three trips to Carlisle, Pa., to deliver our 12-year-old daughter, Morgan, to Dickinson College, for an intensive program in ballet, and then to visit her and pick her up. We had forgotten what it takes to furnish a college room, but we had fun doing it. We even got to eat in the cafeteria. Happy holidays!—**Karen** and **Greg Arenson,** secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023; e-mail: <dhbm13d@prodigy.com>

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Janet Koch writes, "I am happily married and still working for the World Bank after 16+ years. I work on energy and infrastructure projects in Russia and Central Asia. We live in a tiny house, nearly 200 years old, in downtown D.C. Our 80-foot deep and 16-foot wide garden is our retreat during weekday evenings, and our Crealick 37-foot sailboat is our

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retreat for cruising on the Chesapeake Bay on weekends. Future plans include some ocean cruising. . . . **James A "Andy" Howell** retired from the U.S. Air Force in 1994 and is now living in Gainesville, Ga., with his wife, Cathy, and his dachshund, Jasmine. He enjoyed the 25th reunion at MIT very much. . . . **Adrian Bejan** was selected to receive the 1996 Worcester Reed Warner Medal for his "originality, challenges to orthodoxy, and impact on engineering thermodynamics and heat transfer" which were demonstrated in his first three books: *Entropy Generation Through Heat and Fluid Flow* (1982), *Convective Heat Transfer* (1984), and *Advanced Engineering Thermodynamics* (1988). Presentation is at the American Society of Mechanical Engineers International Mechanical Engineering Congress in Atlanta.

Andrea Sanders has joined Rhone-Poulenc, North American Chemicals as VP for research and development. She was previously at Sherwin-Williams Co., where she was director of technology since 1993. She got a bachelor's from MIT in Course V and an MA and PhD in organo-metallic chemistry from Boston University, as well as an MBA from Houston Baptist University. . . . **Elizabeth Dealen** spent the past year on sabbatical in New Hampshire. She has now returned to teaching in the City and Regional Planning Department at UC/Berkeley. . . . **Lawrence D. Poster** is married to the former Amorfina Castillo of the Philippines. They have one son, Geoffrey August Maximillian, who is a great sports enthusiast. Larry is managing director of the Catalyx Group, strategic consultants, executive search and corporate finance advisors to the life science and new media industries with offices in New York, Princeton, Menlo Park, and Ottawa. He is a member of the board of directors of the MIT Enterprise Forum of New York, a member of the International Advisory Board of Ramapo College, and a member and occasional thespian with the 100-year-old Amateur Comedy Club of New York. Larry and his family make their home in Upper Montclair, N.J. . . . Be sure to see the photo of **Nancy** and **Don Rosefield** on page MIT35.

Please send news for this column to: **R. Hal Moorman**, secretary, Box 1808, Brenham, TX 77834-1808; fax: (409) 830-0913; e-mail: <moorman@phoenix.net>

72 25th Reunion

Our 25th reunion is next June, and we are forming a reunion committee to organize plans. Anyone who is interested in helping or who has ideas is encouraged to contact our class president, **Bonny Kellermann** at: <bonnyk@mit.edu>, or by phone: (617) 232-7140 (h) or (617) 253-9722 (w). You can contribute to event planning, help with our reunion book, volunteer to contact classmates to encourage their attendance, or serving on our gift committee. Bonny also writes, "For the past 11 years, I have been skating competitively on an adult precision team. (Precision skating is a bit like 'Rockettes' on ice.) We recently won the national championship. We've won nationals four of the last five years and have been East Coast champions since 1988. Also, I am pleased to announce that the Class of 1972 now has a home page on the Web. The address is: <http://web.mit.edu/alum/www/class/mit1972/>. Many thanks to class Webmaster, **Michael Lieberman** and to John Blake of the Alumni/ae Association for his assistance. The page includes class member e-mail addresses known to the Alumni/ae Association. (If yours is not there, use the handy reply feature on the page to send it in.) We also have a list of class members with no current address. If you know the whereabouts of any of these people, please encourage them to contact the Alumni/ae Association or do so yourself on their behalf. We'll want to be sure to have address information as we get ready to send out mailings about our reunion. You can also use the page as a quick, convenient way to send messages for our Class Notes column. If you have ideas for other things you'd like to see on the page, let me know.

Tom DiPrete, a professor of sociology at Duke University, is spending the 1996-97 academic year in Europe at social science research centers in The Hague (The Netherlands) and in Berlin. He hopes to bring a bi- or tri-lingual family back to the U.S. in the fall of 1997. . . . **Frank A. St. Claire** has joined the law firm of Strasburger & Price in Dallas as a partner, focusing on commercial real estate law and litigation. . . . **Brad Billetdeaux** writes that he is "using mathematics training from the Institute days to blend cleaner gasoline to improve the environment.". . . **Bill Reenstra** writes, "After almost 15 years in Berkeley, I moved to Wilmington, Del., to accept a job at the Alfred I. duPont Institute. I direct a research laboratory that is studying the genetic disease cystic fibrosis. My wife, Karen, is still living in Berkeley and we are both spending a lot of time at 37,000 ft.—**Dick Fletcher**, secretary, 135 West St., Braintree, MA 02184

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William Marberg was named president and CEO of Wilcox Electric of Kansas City, a supplier of navigation and landing systems for the U.S. and many foreign nations. He is a veteran of the air traffic control industry and had joined Wilcox after a career at Loral Corp. He is the former chairman of the Air Traffic Control Institute, publisher of *Air Traffic Control Quarterly*, and an industry conference chairman.

I'm looking forward to a Phi Delt reunion shortly with MIT Classes 1973-79 in attendance and friends and brothers not seen in decades.

Write or e-mail!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 7721 Churchill Ct., Marshall, VA 20115 (new zip code); e-mail: <sutton_bob@prc.com>

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John Hurd and Elaine are now living most of the year in Naples, Fla. He has a small office in Lexington, Mass., which is electronically linked to the office in the house in Florida. This is the third year of being on his own. The equipment for the shoe industry is solid, but not enough to keep him busy, so he is also building expert system models for costing. The biggest benefit is getting to play golf

with Elaine each afternoon if he feels like it. . . . **Alan Ritter** tried for the *fifth* time to climb "his" mountain, Mt. Ritter, in the Sierra (about 20 miles as the crow flies south of Yosemite. Alan sent us a detailed trip report, and a short extract follows. "By the time we had reached the one-third mark up to the North Glacier Pass, we were in a veritable blizzard of popcorn snow driven into our faces by a 40-mile-per-hour wind screaming down the pass. The still air temperature was down in the 20s, and the wind chill certainly well below zero. Not exactly what we had assumed for conditions on June 26! With visibility rapidly falling to 100 feet or less, we decided it was foolhardy to try to make it over the pass and down past Lake Catherine and on to Ritter Lakes. We turned around and headed back to Badger Lakes. Set back once again, we were convinced that we had made the right decisions, both in bringing the kids back a day early and in backing down from conditions we were ill-prepared to deal with ourselves. Temporarily set back, but not defeated, I will return again to attempt 'my' mountain."

Martin Cohen is a senior research scientist with Cytec Industries, doing basic and applied research on UV and radical stabilizers in polymers. He lives in White Plains with his wife, Marie, and three children, Jessica, Rebecca, and David. Martin teaches martial arts in USA Goju Karate, in which he holds the rank of second degree black belt. . . . **Gregory Turner** merged his architectural firm with that of another MIT graduate, R. Stanley Bair, '50. They concentrate on mid-size building and interiors projects for institutional and corporate clients throughout southeast Texas. Since Houston's economy has been quite healthy the past few years, his business has been good. He and his wife, Ann, have four children: Matthew, Alan, Patty, and Bobby.

Please send news to: **Barry N. Nelson,** secretary, 65 Hillside Ave., Newton, MA 02165; e-mail: <barryn@world.std.com>

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Please send news for this column to: **Jennifer Gordon,** secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036; e-mail: <gordonj@pennie.com>

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The mail has been the only vehicle for news for this issue of the Notes. Please write. We urgently need news!

Martin Fuchs writes that he "recently accepted a position as head of product development at Active Impulse Systems, a fledgling startup aiming to commercialize some technology coming out of MIT for thin film characterization. My family is doing well. Daughters Hannah and Sophie are 3 and 7.". . . **Ed Crawley** has been promoted to head of the Department of Aeronautics and Astronautics, effective July 1. Ed has spent his entire career at the 'Tute.

Since the elections in Israel, your secretary has received a number of requests to learn if Israel's prime minister, Benjamin Netanyahu, is a classmate of ours. Regretfully, the answer is no. (For more about his career at MIT, see page *MIT 36* of the August/September *Tech Review*.)

The reunion produced the following class election results: president, **Bob Lepkowski;** vice-president, **Steve Spura;** treasurer, **Lee Silberman;** secretary, **Arthur Carp;** members-at-large, **Chris Roberts, Bob Blau,** and **David Lee.** On behalf of all of us, your secretary wishes to thank **Tom Martin,** our outgoing president, for his many efforts on behalf of our class. And I wish to thank you all for re-electing me as secretary.

News for the Notes remains in short supply.—**Arthur J. Carp,** secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523; tel: (516) 295-3632; fax: (516) 295-3230; e-mail: <quant@dti.net>

77 20th Reunion

Please send news for this column to: **Ninamarie Maragioglio,** secretary, 9727 Stipp St., Burke, VA 22105

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Please send news for this column to: **Jim Bidigare,** secretary, 9095 North Street Rd. NW, Newark, OH 43055-9538; tel: (614) 745-2676; fax: (614) 745-5648

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Dave Boccuti has a new job at Intelligent Automation Systems, an engineering design and automation consulting firm in Cambridge, Mass. His previous job moved away (from Norwood, Mass., to Connecticut) so he opted out. He has been learning HTML programming, and invites everyone to visit his home page: <http://pwp.usa.pipeline.com/~adboccuti/>. . . . For the last two years, **Bernard Beard** has been commuting from his home in Memphis, Tenn., to MIT to finish a PhD in theoretical physics. Happily, he has completed his degree and is returning back home to begin work this fall as an assistant professor of physics and mechanical engineering at Christian Brothers University. His wife, Natalie Kerr, an opthalmologist, and son Bradford (age 1 1/2) can now breathe a sigh of relief!

Please send news for this column to: **Sharon Lowenheim,** secretary, 98-30 67th Ave. Apt. 6E, Forest Hills, NY 11374; e-mail: <lowens1@pfizer.com>.

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As I write this, it is early August and I have received only one postcard in response to my contest. It could be a winner in more than a few categories. **John Bard** sent a card of sumo wrestlers (original) from Japan (distance). He was there on business for Sun Microsystems. John has been at Sun for eight years, primarily in server marketing. He is cur-



The Class of '76, winners of the Tech Challenge Games at Reunions

PHOTO: L. BARRY HETHERINGTON

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rently involved in integrating Cray's high-end SPARC servers into their product line. John and his wife, Maureen, live in Palo Alto with their daughter, Julia, and son, Henry. They occasionally see Bill Cimino, '79, and **Mike Van Riper,** who also live in the Bay area. They have also visited **Paul Hajian** in Boston and **Doug Ward** in Washington, D.C. John also writes that **Bob Vieraitis** left Sun last year for an Internet startup and ran into **Eric Pearson** at a bookstore in Menlo Park last winter. I hope I get some more postcards. If you take winter vacations, you can enter the winter version of this contest. Send your funniest, most picturesque, or original postcards from the far corners of the world!

John Hengeveld started with us in 1976 but didn't graduate until 1989. He remembers many of us with fondness and e-mailed me an update. John is happily married and living in Aloha, Ore., with his wife of 11 years, Jennifer Brent, and two children, Essie and Brent. He is the engineering manager for the accessory products product line at Tektronix. This past January, John was the conference chair for the AEA Innovation Now Conference and is currently president and CEO of the Autism Society of Oregon. For fun, John plays with his kids or on-line duplicate bridge on the Internet: <www.okbridge.com>. John had the opportunity to send me many postcards this summer—he drove from Portland to San Jose to Yosemite to Moab, Utah, to Denver to Ft. Madison, Iowa, to Indianapolis to Allentown, Pa., to Ithaca, N.Y., to Boston! He flew home without his family and went back three weeks later to drive them home. As he says, "Still crazy after all these years!" . . . **Basil Safos** and his wife, Liliana, have lived in Memphis, Tenn., for five years but would like to get back to the Northeast. They are parents to Constantine Just a short note from **Thomas Vasicek:** He started a new job at Millennium Pharmaceuticals in June.

Send your news to: **Kim Zaugg,** secretary, 549 Fairfield Rd., Canton, MI 48188; tel: (313)981-1785; e-mail <vayda@erim.org>.

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Please send news for this column to: **Mike Gerardi,** secretary, 412 N. Oakhurst Dr., #202, Beverly Hills, CA 90210; tel: (310) 203-8080 (w); e-mail: <mmg@jmbm.com>

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15th Reunion

Please send news for this column to: **Helen (Fray) Fanucci,** secretary, 502 Valley Forge Way, Campbell, CA 95008; e-mail: <fangroup@aol.com>

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Clearly, **Bryan Liang,** Pepperdine University School of Law faculty member, paid attention in MIT writing courses. He has recently published a number of articles dealing with the legal issues surrounding crack cocaine, in such publications as the *Sacramento Recorder* and the *Los Angeles Daily Journal.* He has also published two case commentaries in *Hospital Physician* and co-written another. He is medicine editor of the *Journal of Clinical Anesthesia.* . . . **Layton Montgomery** has spent the last two years teaching math and computers at Kiev International School in Ukraine. This past year he developed a full elementary level curriculum on Macintosh computers, a course for high school students, and database spreadsheet programs. He also does yoga and meditation. Layton says the Ukraine winter was particularly harsh, but he did have the opportunity to chaperon some of the older school kids for four days of skiing in the Carpathian mountains. He plans to spend one more year teaching in Kiev and then hopes to return to Nepal.

Sarah (Henderson) Scheuch worked in engineering for Corning, Inc., for 11 years, then switched to teaching. She just finished her first year teaching first grade and has been promoted to third grade for next year, which will enable her to do more with the kids that involves math and science. Sarah announces the birth of her daughter, Kate, on May 5, 1996. She also tells us that **Steve** and **Eileen (Seligson) Janowsky** had a baby girl on April 13 of this year, and **Sue Strausman Rietti** and her husband, Giorgio, had their third child, Francesca, on October 9, 1995. Francesca joins her brother, Luka, and sister, Anna. . . . **Steve DeFalco** e-mailed to say that he has left McKinsey to join United Technologies. He is a director in the strategic planning department, where he will spend 12 to 18 months and then rotate into a general manager's slot.

Please keep those cards, letters, and research reports coming!—**Jonathan M. Goldstein,** secretary, c/o TA Associates, High Street Tower, 125 High St., Suite 2500, Boston, MA 02110; fax: (617) 574-6728; e-mail: <jgoldstein@ta.com>

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Please send news for this column to: **Jonathan Miller,** secretary, 1708 Plaza Ct., Mountain View, CA 94040; tel: (415) 813-1100 (w), (415) 961-2394 (h); e-mail: <jonathan_miller@logitech.com>

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Greetings from the dog days in Pittsburgh. **Ernie Fasse** sends a note from the Southwest: "I'm in Tucson at the University of Arizona, with the aerospace and mechanical engineering department. I'm working mainly in control of spatial manipulators, and also working on applying robots to assess human perceptual-motor performance. My hobby (and my wife's bane) for approximately the last six years is playing banjo. I submitted some arrangements to the world's foremost banjo rag, *Banjo Newsletter.* So cross your fingers, maybe I'll be a published arranger!". . . . **Ruth Fricker** writes: "I'm going to be married to Jason Van Sciver this September in Maine. We are still working on the wedding planning, but we've got the honeymoon all figured out! We're spending a month in Ecuador, first bumming around on the mainland, then chartering a boat in the Galapagos for several weeks of scuba diving. Jason and I both work for Guidant Corp. in Santa Clara, Calif. I've been doing business process reengineering for

several years now, and I am really enjoying it. My real passion though is underwater photography. I've been winning prizes here and there this year.". . . **Alan Williams** writes, "I just got married (on July 6, 1996) to Susan McLaughlin, who just got her master's in public health. (We've been dating for over three years and have traveled together for five months through SE Asia and the South Pacific in 1995.) A bunch of MIT classmates were able to come out to the Left Coast for the four-day event, including about 15 Fiji brothers (many with spouses). I've been at Apple for about a year now and am weathering the rough times."

And from **Julie Forman-Kay:** "I have been living in Toronto with my husband, Lewis Kay, for four and a-half years, working as a scientist in the Research Institute of the Hospital for Sick Children, with a cross appointment on the faculty of the University of Toronto in the biochemistry department. Lewis is also a scientist doing NMR methods development for protein studies. We have been enjoying traveling together to science conferences: Stockholm in 1994; Australia and Hawaii in 1995; and California and other assorted places in North America in 1996. We have lived in a beautiful house for almost three years but have no kids yet to fill the bedrooms." She reports that she plays violin in a couple of quartets and is involved with her synagogue. Julie keeps up with **Gordon Linoff** in New York City. . . . **Mina Fader** is still at the Franklin Mint, currently serving as director of marketing and finance. In late August, she and husband Peter Fader, '83, moved to a house in Bryn Mawr with lots of grass, trees, and a swimming pool for Shayna and Corey. . . **Eve Durra** married Emile van den Bol. Eve works for Merrill Lynch in the private sales and divestitures department, and Emile works for Lehman brothers in asset backed securities.

Send news to: **Bill Messner,** secretary, 5407 Pocusset St., Pittsburgh, PA 15232; tel: (412) 421-4334; e-mail: <bmessner@cmu.edu>

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Kathleen Kelly, after completing a residency in internal medicine at St. Elizabeth's Medical Center in Brighton, Mass., is now working in a civilian clinic on Hanscom AFB affiliated with St. Elizabeth's. She's looking forward to attending the wedding of **Greg Harrison** and Nichole Mihara, whom she introduced to each other. She hears that **Ray Covert** and Dave Glassner, '88, and their families are living in Virginia. Having recently been certified in SCUBA (38-degree water off Gloucester on April 28), Kathleen is looking forward to a Hawaiian vacation to visit family and get some warmer practice.

David Cultice works for Asyst Automation in Wilmington, Mass., developing semiconductor capital equipment. He is corporation treasurer for the MIT Chapter of Theta Xi. . . . **Kelly Grant Craven** writes that she has been "lucky enough to become a stay-at-home mom to a beautiful, healthy baby girl, Jaime, born in 1995." She and her husband, Chris Craven, '84, are expecting a sibling for Jaime later in '96. "I am still highly involved with the game of rugby and am looking forward to playing again next year, since my team is the 1996 National Champion.". . . **Roy Briere** is a post-

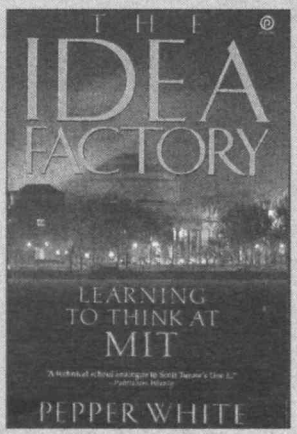
ClassNotes

doc at Harvard, but he actually lives and works at Cornell on a high-energy physics experiment. "After getting a PhD, now I can start enjoying some of the nicer conferences in my field. Last one was in the French Alps; next one near Paris."

M. Anjali Sastry writes that he is assistant professor of organizational behavior at the University of Michigan in Ann Arbor. **Bobby Greenfeld** graduated from NYU Law School in 1995 and has been clerking for a federal judge in Washington, D.C., for the past year. Starting in the fall of 1996, Bobby will be working at an intellectual property law firm in New York City. . . . **Vic Christensen** is still working for the Brilliant Eyes program, but they were taken over by the Space Based Infrared Systems program (think of a Borg assimilation) and ". . . life is not good. I'm deciding whether to stay in the Air Force or become a silly-villain.". . . **Homero L. Rey** finished a PhD in cell biology at UC/Berkeley this May and started working for Technical Instrument Co. (a microscopy systems manufacturer) in June as a senior application scientist for their confocal microscope. He was recently engaged to Camille Mojica (UT/Austin, '90) who is currently finishing a PhD in integrative biology at UC/Berkeley before going on to the scientific writing program at UC/Santa Cruz. They are currently residing in San Jose.

To be added to our class e-mail list, or to

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87 10th Reunion

Hey guys! Just a friendly reminder that our reunion is coming up sooner than you think. It's not too late to sign up to help. E-mail **Greer Tan Swiston,** our reunion co-chair, at <gswiston@fmrco.com>, so that she and her husband (and co-chair), **Rob,** can get you on the list.

Mark Wang, who was elected to the MIT Corporation in 1994, attended the June 1996 Commencement exercises and sat with other Corporation members on stage near the commencement speaker, Vice President Al Gore. As a policy analyst with the RAND Corp., Mark went on a two-week trip to Bosnia, Croatia, Hungary, and Germany this past May, to research logistics for Operation Joint Endeavor. In June, Mark and his wife, Sally, participated in the MIT Club of Southern California's day with Habitat for Humanity, and ran into **Al Cangahuala.** Al currently works for JPL. Mark also recently saw **Kevin Ray,** who was attending a conference in Palm Springs. Kevin currently does research for the Air Force at Hanscom AFB near Boston, and lives in Nashua, N.H. He brought Mark (and us) up to date on the whereabouts of a number of classmates. . . . **Eric Daly,** manager of the U.S. Men's Volleyball team, planned to walk with the athletes at the opening ceremonies of the Olympics.

Chung-Pei Ma recently completed a postdoc in theoretical physics at Caltech and is now on the physics faculty at UPenn. . . . **Eric Twietmeyer** just left Looking Glass Technologies and has joined an upstart computer game company located in Arlington, Mass., but affiliated with 3Dfx of Silicon Valley. . . . **Geoffrey Kelsch** just got back from a three-and-a-half-week tour of New Zealand and Australia. While there, he spent five days with **Tom Hoffman** and his wife, Christine, who live in Wellington, N.Z. Tom works as a manufacturing director for Colgate Palmolive at their production plant. They have a great little house on the waterfront and are enjoying life Down Under. Geoffrey is in the process of moving from Washington, D.C., to Los Angeles, where he will begin working for Hughes Aircraft. . . . Also returning to the States from Australia is **Arun Ram,** who has become a member of the Mathematics Department faculty at Princeton University.

From Down Under to the Top of the World, **Julianne Marquet** is currently in a third-year residency in family medicine at the University of Washington. She just got back from two months in Alaska. Julianne has been enjoying her stint in the Northwest and has even picked up kayaking. . . . **Bradley Feld,** (also SM '88) was just named chairman of Virtuflex Software, a Web-based software tools company started in Cambridge by two MIT graduates. Virtuflex recently acquired the net.Form product line from net.Genesis, which Bradley is also chairman of. He has also joined the boards of Genetic Anomalies, a startup company developing Internet game studios, and the Young Entrepreneurs Organization, where he will also serve as the VP for marketing and sponsorship. . . .**Vicky Rowley** says "hi" to all and wants everyone know that she is in San Diego. She can be reached at <vrowley@sagacitech.com>.

Lots o' babies! **Steven Rohall** and his wife, Alex, had a baby boy on June 24. Cameron James checked in at 9 pounds, and was 21 inches long. Steven is still working at TASC in Reading, Mass., on collaborative software, network services, and database access. . . . **Frank Griffith, Jr.,** and his wife, Donna Lucas-Griffith (Spelman '87), just celebrated the birth of their first child, a beautiful little girl named Aliyah (pronounced ah-lee-ah) Giselle, born on the 4th of July! Frank works at Hewlett-Packard Medical Products Group in Andover, Mass., as a manufacturing development engineer. . . . **Beth** and **Simson Garfinkel** had a daughter, Sonia Kineret, on July 19, 1996. She checked in at 6 pounds, 4.5 ounces and was 18.5 inches long. . . . Ken, '89, and **Lori Avirett-Mackenzie** proudly announce the birth of their daughter, Mathilda Simone, born May 17, 1996, and weighing 8 pounds, 2 ounces. Lori will shortly return to her position as product manager at BayBank, while Ken continues to work on a PhD at MIT in Course VI.

Thanks for writing! Send any hot tips you may have too!—**Jack Leifer,** secretary, 116J Fairway Ridge, Aiken, SC 29803; e-mail: <mit1987@mitvma.mit.edu>

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Please send news for this column to: **Catherine Suriano Singer,** secretary, 131 Main St., Andover, MA 01810; e-mail: <singer@allegro.mit.edu>

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Thanks to everyone for sending in news! This month's list of people to please send news is: **Dorit Brenner, John Flight, Jennifer Gaus, Patrick Wee, Eric Rizzotto,** and **Wilson Wong.** What are y'all up to? If anyone knows about any of these people or other classmates, please write in.

Melanie Violette, who responded to last month's hit list and whose name I misspelled (sorry!), and husband **James Violette** are living in Pflugerville, Tex., with their 2-year-old son Patrick. Melanie is a PhD student at the University of Texas at Austin, in the Department of Aerospace Engineering and Engineering Mechanics. "My research is on compression testing of composite materials," Melanie writes. James is working for IBM in Austin and also pursuing an MS in software engineering from Univ. of Texas. . . . Class President **Carissa Climaco** and **Kenney Ng** were married June 15 (see photo) at the MIT Chapel, with a reception following at the MIT Faculty Club. **Cindy Wang** was the maid of honor, and **David Gebala** was the best man. Among other MITers in attendance were bridesmaids **Alison Miyamoto, Karen Yu, Suephy Chen, Vivian Liu;** groomsmen Richard Gueler, '88, Alejandro Caro, '90, Shirley Weigl, '90, Bo Trieu, '90, **Derek Chiou,** John Warren, '91, Harald

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Weigl, '90, Javier Zugasti, '88, and wife Jen; **Aaron McPherson** and wife Amy; Rita Cha, '88, and myself. Kenney has returned to MIT for a graduate degree after working at BBN for several years, and Carissa finished an MS in urban studies and planning at MIT and returned to her former employer, ABT Associates. Among those in the wedding party, Karen finished a psychology degree and is now teaching at Vanderbilt; Suephy is in a dermatology residency in Atlanta; Alison is at Stanford; Vivian is a postdoc at Stanford; David is working for Motorola; and Alejandro is at MIT working on a PhD. More photos are available on our Web site.

Jerrold Boxerman and Heather Robin were married June 2. After finishing up in the MIT/Harvard MD/PhD program, Jerrold began a residency in radiology at Johns Hopkins Hospital, and Heather, after finishing at Tufts, began a residency in internal medicine at Sinai Hospital, both in Baltimore. . . . **Arya Akmal** reports the birth of son Dmitry Kaveh Akmal on April 20. . . . **Jim Reich** is now working at Lockheed Martin Advanced Technology Center (dynamics and controls laboratory) in Palo Alto, Calif. . . . **Paula Aqui** is is working for Amoco in Petit Valley, Trinidad, West Indies. . . . **Christine LeViness** recently started a new job at a small technology company, System Management Arts. . . . **Matthew McCarth** is living outside Washington, D.C., and is working at Lockheed Martin. . . . **Ron Dagostino** left Fidelity Investments in June to take a software development job at State Street Global Advisors. Ron, wife Sheryl, and son Eli are moving to Martha's Vineyard in September. "In case you're wondering how I can live on the Vineyard and still work in Boston, I've arranged to telecommute from home four days a week." . . . **Barry Margulies** received a PhD from Johns Hopkins in May and was married on June 2 to Sun-Hee Kim. After honeymooning in San Francisco and Hawaii, Barry started a postdoc at Hopkins School of Medicine in the Division of Comparative Medicine, working on simian immunodeficiency virus and visna viruses. . . . **Teri Centner** is now living in the Washington, D.C., area, and has been staying with Greg Greeley, '86, until finding permanent housing. "House-hunting is slow, since I've never had to pay this much rent or face an ugly commute like this before." Teri put her sorority, Sigma Kappa, on the Web and demonstrated it at the Sigma Kappa National Convention in Washington at the end of June. On her way across the country, Teri visited with **Cristina Vilella** who is doing quite well at Scott Air Force Base. One of her neighbors is **Jeff Pearson,** so the three got together one night. . . . **Dan Teal** and his wife, Janet, are expecting their first child at the beginning of 1997. Dan recently co-founded the computer network security company WheelGroup, as chief scientist. . . . **Kyle** and **Maureen Robinson** have moved to Seymour Johnson AFB, N.C., where Kyle is now flying F-15s. . . . **Rob** and **Wendy Introne** are living in Herndon, Va.

Max Ochoa, class secretary '90, writes in with this report from **Alan Nash**'s bachelor party in San Francisco in June: Al is marrying Sheila Borghi and has started his own company, Practical Imagineering, based in Virginia, with his partner, Dave Eldred. Joining the debauchery (which included Al's trapsing about much of the city with a bowling ball and chain padlocked to his leg) were several of Al's Sigma Chi brothers. **Keoki Jackson** was a key figure in the commission of the bachelor party, which was held, in part, at **Chris Maeda**'s pad in SoMa. Keoki is pursuing a PhD in Course XVI and Chris is busy finishing a PhD dissertation while working for both Xerox and a start-up. **Dave Morales** is entering his last year at Hastings Law School.

Marcia Smith and husband Steve Smoot, '90, are living in San Francisco where Steve is finishing a PhD in computer science from Berkeley and doing the start-up company thing. Marcia is still at UC/SF school of pharmacy. Marcia writes that they "see lots of MIT alums—especially at 'Dinner Club.' Every second Sunday of the month we host a fest where there is food from a different country/region/theme. In addition, some months we have 'aspiring artist' things to dabble on while here. It's an open event —if anyone is in the Bay Area, feel free to come by! Some of the alums that drop by are **Tim Steele, Dave Miller,** JaiYoung Kim, '90, Jean Kim, Ben Wen, '91, Jen King, '91, Derek Yim, '92, **Mike Romero,** Irene Shen, '90."

On June 30, **Lori (Aronson) Andersen** finished a pediatric residency at Boston City Hospital (Boston Medical Center as of July 1) and will be joining a private practice in Newton. Lori writes, "The practice is called Pediatric Health Care at Newton-Wellesley (for all you Greater Bostonians in need of a terrific pediatrician) and is based at Newton-Wellesley Hospital and will be a completely paperless office. Nathan Samuel Andersen was born to Lori and Mark on July 3. Mark is working for Boston Treasury Systems in Cambridge, where he is a senior software engineer. Mark finished a political science PhD from Harvard this past spring. While in the San Francisco area last October, Lori and Mark touched base with Loren Chow, '90, who's continuing to work on a PhD in Materials Science in California. They also met up with **Paul Friedman,** who is happily motoring around the area when he's not working in downtown San Francisco. Lori reports that **Kia Freeman** and Bill Gode-von Aesch are now engaged. Kia is also working on plans to go to law school in California. . . . **Laura (Ryzowicz) Rapacioli** is working at a law firm this summer between her third and fourth years of night law school and wants to work in environmental law when she graduates. . . . **Carlos Barreto** lives in Minneapolis, has now bought his second house (he sold the first one), and is now working for Seagate. "He's been quite enthusiastic about the move and about living in Minneapolis in general," Lori writes.

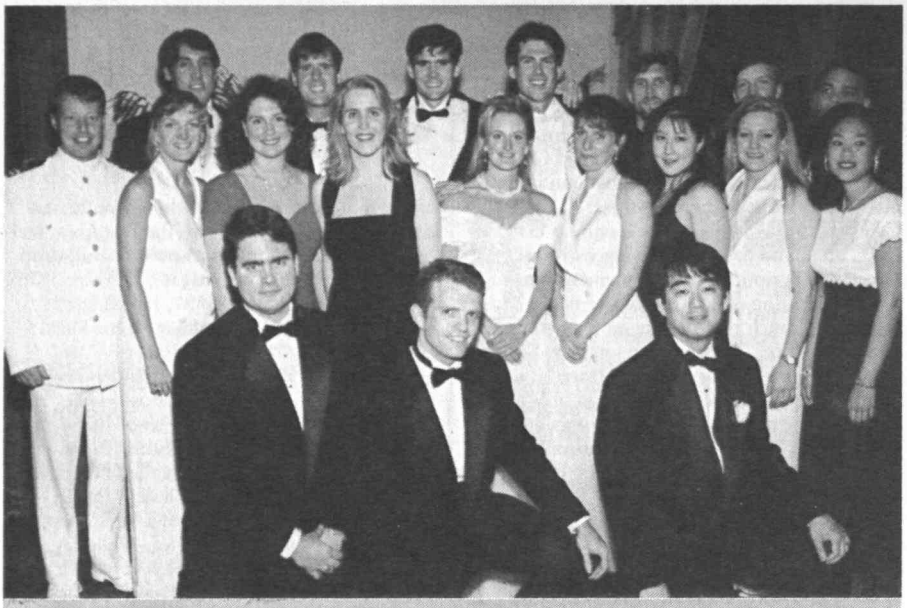
Well, that's it again for this month. More members of the class have home pages, so be sure to check out the '89 home page at <http://www.tns.lcs.mit.edu/mit89/> and send your URL if you have some info. Also, if you'd like to have photos put up on our Web site and don't have a scanner, I'll scan them and return them to you! For those of you who actually send in U.S. mail, please note my address change, effective September 1.—**Henry Houh,** secretary, 70 Amherst St., Cambridge, MA 02142; tel: (617) 225-6680; e-mail: <hhh@mit.edu>



MIT alums at the June 15, 1996 wedding of Carissa Climaco '89 and Kenney Ng '89: From left to right, (front row) Derek Chiou '89, Henry Houh '89, Alejandro Caro '90, John Warren '91, Harald Weigl '90, Javier Zugasti '88, Aaron McPherson '89, (middle row) Alison Miyamoto '89, Karen Yu '89, Cindy Wang '89, Kenney Ng '89, Carissa Climaco '89, Suephy Chen '89, Vivian Liu '89, Shirley Weigl '90, Richard Gueler '88, Jen Zugasti W91, Amy McPherson W93, (back row) David Gebala '89, and Bo Trieu '90.

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Andrew "Tippy" Knoedler (XVI, PKT) reports that Audra gave birth last July 26 to a 9 lb. 12.9 oz., 21.5 inches long baby boy. She and Alexander are doing well. . . . **Gary Robinson** (II, MacGregor) checks in: "I just got married to Kristi Kernen in lovely Hawaii. **Scott Stevens** served as best man. I'm still in the Air Force, and they're paying for an MS program in imaging science at Rochester Institute of Technology (I'm halfway there—one more year)." . . . Awhile back, I asked for members of various sports teams to write in, and **Robert Martin** (XVI, Fiji) accepted the



The MIT members of the wedding party of Dawn Mitzner-LaPorte, '91 (middle row center), and Paul LaPorte, '88 (back row center).

challenge. He says, "After getting a master's in aero/astro from the University of Tokyo, I joined Ultratech Stepper, a semiconductor equipment manufacturer in San Jose. I was in San Jose for a little over a year before I got transferred back to the Japan office in January as an applications engineer. I am definitely enjoying Tokyo more now that I have an income; it was a tough place to be a student!" . . . **Takiko M. May** recently completed an M.A. in English at Auburn University (Ala.) and has moved south to Mobile to attend medical school at the University of South Alabama.

Things have been going well for **Jema Gonzales**. She and Mark recently went to Grand Cayman—their first dive vacation. "We did the classroom and pool instruction before we left, then did our four open water certification dives the first two days there. It was awesome!". . . **Jerelyn (Watanabe) Apo** is back home in Hawaii. "Remember me from the swim team? I've been swimming on and off since MIT in some master's programs and more recently in the ocean. I'm trying to expand to some new water sports, paddling canoes (Hawaiian style) and kayaking, so I swim and run for cross training. I'm married but no children (thank goodness). I've been back in Honolulu for a year now, teaching high school physics and math and coaching girls cross-country and paddling at Punahou. I'm also working on a project to integrate the learning of art and science using technology. Most of my teachers are now my colleagues! When I tell people that I went to MIT and I'm a high school teacher, they think I'm either crazy or had really bad grades. But I actually feel I can have more influence in science at this level than if I became a researcher. One of my students will go to MIT in the fall to study computer science." . . . At a party with many oft-mentioned MIT alums here on the Left Coast, I saw **Yashodhan (Billo) Naravane.** He's working for Netscape in NYC and is doing well. Also at Netscape this summer is **Jeff Meyer** (DU). He heads back to Chicago B School in the fall. . . . **Jason Satterfield** (DU) chimed in: "Finished a PhD in psychology in April 1995 from UPenn. Finished a postdoc at UCSF in June 1996, looking at treatments for clinical depression. Just started a faculty position at UCSF as an assistant professor in the Division of General Internal Medicine."

Also getting a start in academia is **Walid Azzam.** "After graduating from MIT, I came straight to Stanford where I completed an MS in applied physics and recently a PhD in astrophysics. I'll be an assistant professor at the United Arab Emirates University starting this fall.". . . **Tyrome Brown** writes: "For the last six years, I have been moving back and forth from Canoga Park, Calif., and Tucson, Ariz., due to my job with Hughes Aircraft Co. But I did manage to stay in one place long enough to earn a master's in electrical engineering from Caltech. Now I'm off to Stanford Law School. I went to New York a couple of times to see fellow alumnus William Chan, '89, Ilham Ahmed, '91, Sabet Chowdury, '91, and Leonard Singh, '91. Loitered around Santa Monica with Jason Chiu, '89, before he transferred from UCLA medical school to UC /San Diego." With Tyrome's appearance this fall, Stanford Law School now proudly sports a Class of '90er in each of the three classes at the law school. . . . **Erica Kuo** is a 3L (i.e., in her third and final year), your humble servant **Max Ochoa** is a 2L.

This just in from **Genevieve Sparagna**: "I just got a PhD in biophysics from the University of Rochester in April, and now I'm doing a postdoc at the University of Connecticut Health Center."**Tim Stellmach** is in the serious business of computer games. "I'm living in Somerville, having bought a house in partnership with a number of friends and alumni (**James Fleming**, Nick Carter, '91, John Buck, '89, Doug Church, '89, Dan Schmidt, '91) that we also rent to Marc Leblanc, '89, and Erika Schutte, '91, in a model of capitalist exploitation. I've been working for a number of years as a game-software designer at Cambridge-based Looking Glass Technologies. At LGT, I've worked on Origin Systems' Ultima Underworld series and System Shock and Looking Glass' own Terra Nova, Strike Force Centauri. Currently, I'm lead designer on what will be the first *Star Trek: Voyager* computer game."

Daniel S. Chen writes, "Life has been good this past year. I married Deborah Quinn in Pasadena, Calif., October 7, 1995. In attendance were many MIT alums. In the bridal party were my brothers and best men, Edmund Chen, '95, and Felix Chen, '96, and my friend from the MIT Ultimate Frisbee team, Christopher Corcoran, '84. Also in attendance were Ultimate team member Michael Lawler, '93, and my Theta Delta Chi brethren **Micah Adler, Zain Saidin**, Chris Niessen, '93, Michael Genrich, '93, Terry Spurling, '93, and Rafael Bejar, '93. **Joanne Spetz** and Jennifer Sokoloski, '89, also joined the festivities. After returning from a honeymoon that included Paris and a tour from Tuscany to Rome, I defended a PhD in February 1996 (microbiology at USC with Dr. Michael Lai). I then spent six months as a postdoc in W. French Anderson's gene therapy lab before returning to medical school for the last two years of an MD/PhD program. Currently, we are moving into a house in South Pasadena, and we are expecting our first child in December." Thanks for the awesome update. Also checking in is **Lisa Evelsizer:** "I am working at JPL on the Mars Pathfinder Project. August through December I will be working at Kennedy Space Center getting the spacecraft ready for a December 2 launch. I recently spent a fun weekend in San Diego with Glenn Eswein, '91, and Vicky Rowley, '88, where we biked along the shore and ate too much excellent Thai food."

Getting the just-under-the-wire award is fellow Baker denizen **Jack Kotovsky**. He says, "After graduating, I continued at MIT in Course II for a master's in the Newman biomechanics lab under Dr. Rosen, working with rehabilitative products for the tremor-disabled. I graduated in '92 and went to Paris for a year as a fellow and the first American student at Le College des Ingenieurs. I completed their business program in '93 and had a great time in Europe. J'adore La France! I began a PhD at UC/Davis in the fall of '93 and am working to finish my research in the ME department, and I am instructing my second course at UCD now. Recent fun has included running as a "dog" in the San Francisco urban iditarod and driving a float in the St. Patrick's day parade. **Don Euwart** spent some time in Atlanta taking in the summer games. He attended the reopening of Centennial Park. . . . **Maureen Kenneally** has been hitting the links with fervor. When she's not golfing, she's working in veterinary medicine. . . .**James Dailey** (XVI, Chi Phi) left grad work at Penn State in August 1995 to work for Congresswoman Sheila Jackson Lee. He is responsible for her Science Committee duties as well as issues of health, environment, small business, and energy. "I am having fun living in DuPont Circle and am taking advantage of Washington, D.C."

Also in D.C. is **William Niehaus** (XVIIIC, Random). He is working for Scientific Research Applications after earning a PhD from Carnegie Mellon in a cooperative program of the mathematics, computer science, and industrial administration departments. . . . **David Yosick** (IV, TDC) married Bonnie M. Gee (Wellesley, '91) in July 1995 in a botani-

cal garden in Portland, Ore. He is currently working at BOORA Architects in Portland. "I managed to survive my first Olympic-distance triathlon in Michigan in August. The water temprature was a balmy 48F and I never want to be that cold again in my life!"

By the time you read this, our class Web page should be up and running: <http://web.mit.edu/alum/www/>. To receive this column by e-mail when it is submitted to the *Review* (i.e., uncensored! unedited! and three months before publication), send a message with your e-mail address to <mitalum@mitvmc.mit.edu>. To be removed from the list, send a message to that effect to <jblake@mitvmc.mit.edu>. To change your s- or e-mail address with the Alumni/ae Office, send a message with all your new info to <mitalum@mitvmc.mit.edu>. This will ensure *Technology Review* and the Class Notes get to your hot little hands even when you move (electronically or corporally)!

Be sure to keep on sending in your news. Your classmates will think you're a total champ! Happy Holidays!—**Max Ochoa,** secretary, Crothers Hall #89B, Stanford, CA 94305; tel: (415) 497-6902; e-mail: <mochoa@leland.stanford.edu>, <mit1990@mitvma.mit.edu>

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I am sitting in a hotel in Redwood Shores right now, writing these notes, and enjoying my time in the Bay area. I've been hanging around with **Alisa Mosler,** who should be graduating from Stanford with a PhD in chemical engineering sometime during the summer of 1997. She has become an avid volleyball player and rollerblader. She has lots of news about many of our classmates. . . . **Gayle** and **Will Schnorr** are living in Philadelphia, where Gayle is attending law school at UPenn and Will is working. . . . **Sara Bottfeld** has switched careers and is a publicity agent in Los Angeles. . . . **Marni (Gittleman) Abramowitz** and her husband, Kenny, have made the big move to Charlotte, N.C., where they are becoming acclimated to a new environment. . . . **Danna** and **Jeff Feldgoise** are still in the Boston area, where Jeff is at MIT grad school. . . . **Kim Mislick** just finished a PhD in chemistry at Caltech and will be starting UCLA Medical School in the fall. . . . **Renee DuBord** will be starting Stanford Law School in the fall.

Terry Totemeier writes that he has been working as a metallurgical engineer for Argonne National Lab in Idaho Falls since receiving a PhD in '94. He and his wife, Ann, bought a house there last December. "We love the area—especially being so close to Teton and Yellowstone National Parks." . . . **Cris Bera** writes, "I'll be getting married to Wendy Watkins in July. We plan on spending some time in the Caribbean before Wendy starts law school in the fall. Still working at Southwest Research Institute and am now wearing the uniform of an Air Force Reserve officer since I just transferred out of the Army Reserve last April.". . . **Melissa Norcross** recently sent an e-mail to say that she is leaving her job at Integral to hit Harvard B School for the next two years.

Thought you might be interested in some of **Garrett Love**'s poetry from the Tech Challenge Games at our 5th Reunion. The first is a haiku and the second is a limerick: "*Cambridge parking spot, Cop car can park anywhere, On the Great Dome? Not!*". . . "*An unfortunate lad name of Smoot, Found himself at the great Institute. Though rolled over and over, He claimed he was sober, And his height was just over five foot.*" Decide for yourselves whether we did indeed deserve *not* to win.

USA Today ran an article on May 17, 1996, profiling previous high schoolers who made it to the first nine All-USA Academic First Teams. **Jody White** was one of those mentioned. She is currently a grad student at Caltech in theoretical nuclear physics. Jody has been playing ice hockey in the winter and racing bikes in the summer. . . . **Dawn Mitzner-LaPorte** and Paul LaPorte, '88, were married on May 6, 1995, in West Orange, N.J., and honeymooned on a private island in the Caribbean. Bridesmaids were **Jacqueline O. Bryan-Grizzard** (who was recently married herself on April 1, 1995, to a Navy Seal—both came all the way from Hawaii for the wedding), **Jennifer Uhle,** and Tali Tamir, '89. The best man was John Ramsey, '88, and groomsmen were John Seo, '88, and Tim Mattox ,'88. Other MITers included Shing Yeh, '92, who is now at Michigan B School; Toni Korzan, '92; Marilyn Liang, '90, a pediatric resident at the University of Rochester; **Pat Gannon,** now at Wharton B School; Rich Lightburn, '89; Rob Mitra, '92; **Paul Dans,** now at UVA Law School; Bill Ramsey, '92; Mike Petro, '90; Dave Wright, '88; Dave Evans, '88; and John Krushak, '89. Dawn and Paul live in Maryland now, where Dawn is an orthopedic surgery resident and Paul is an applications engineer at BMC Software.

ClassNotes

Please send news for this column to: **Lola M. Lohr,** secretary, 9835 Reed St., Westminster, CO 80021; tel: (303) 889-8746; e-mail: <llohr@us.oracle.com>

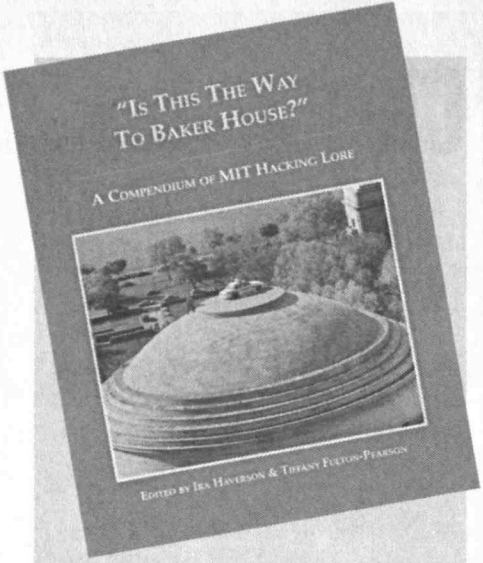
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John Pinder writes that he finished a second year at the RAND graduate school in Santa Monica, Calif., working on a PhD in policy analysis. He hopes to finish in another year or so. . . . **Joe Lettieri** was married last year (November 4, 1995) to his MIT sweetheart, Susan Weakland, '94. Quite a few MIT people attended the wedding. Joe and Susan bought a house outside Akron, Ohio. They are both working at Goodyear as research engineers. Joe is working on an MS at Case Western Reserve University at night. . . . **Heather Hays** was in NYC recently visiting some friends (like **Mike Pieck**). She flew in for a few days from LA, and I was lucky enough to see her—first time since graduation over four years ago! Heather is working for UCLA—contemplating a return to grad school, too.

That's all for now, folks. Not a very busy month. I guess you were all off enjoying your summers, vacationing and playing in the sand. Hope to see everyone next June at the five-



The wedding of Susan Weakland, '94, and Joe Lettieri, '92 ~ Front row, kneeling (left to right): Evan Sherbrooke, '91; Scott Corrington, '92; Jake Yara; '93, Dave Ariano, '91; Andreas Coppi, '91. Back row: Angel Velez, '92; Erin Fujioka, '96; Michelle Starz, '94; Susan and Joe Lettieri; Christine Sai-Halasz, '94; John Vargas, '92; and Brennan Gaunce, '92.



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year reunion! Please contact me if you want to assist in reunion tasks.—**Leslie A. Barnett,** secretary, 2644 Vrain St., Denver, CO 80202; tel: (303) 433-4476; e-mail: <labarnet@ouray.cudenver.edu>

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Thanks to everyone who wrote in. News is always appreciated. I am getting ready to start the school year again. I spent this summer working at the New England Medical Center and moving in with **Kelly Sullivan,** who is in her fourth year at Harvard Medical School. At the moment, Kelly is doing a rotation in Virginia and spending some time with her parents, her brother, and their dog, Loki. She is applying to residency programs in surgery. At the end of July, I went to New Jersey to see my old roommate, Ajanta (Guha) Kumar, '92, and her husband, Ak. She held a baby shower for Shiang (Yeh) Duffy, '92, and Mike Duffy, '92. Also in attendance were **Patty (Birgeneau) Prince,** Chris Prince, '92, and Elyta Koh, '92. Patty will be starting Yale Medical School this fall, while Chris will begin an MBA at Sloan. Elyta just returned from a business trip that started in Rome and finished in London.

J. David Pelly has been VP for corporate development of Diversified Technologies, Inc., a technology engineering and consulting company in Bedford, Mass., for the last three years. He's leaving the company in the fall to earn an MBA at Harvard Business School. . . . **Chris Cunningham** was a key project engineer with Diversified Technologies, Inc., and then went on to complete a master's in electrical engineering at Stanford. He will be living in Baltimore with his Wellesley girlfriend, Krista. Chris and David, along with Marcel Gaudreau, '74, started Marine Technologies, Inc., a marine spill response company last year. . . . **Shahir Salyani** has worked in Cambridge, Mass., as an analyst with Arthur D. Little in the pharmaceuticals group for the past two years and is now a consultant for ADL working in London. He will be returning to Cambridge in the fall. . . . **Kenneth Ricci** took a master's in physics at Stanford University in June and is working on the PhD, with a thesis topic in accelerator and electron-beam physics. On rare occasions, he emerges from Stanford's superconducting accelerator tunnel to be seen with Zia Zaman, '91, who is now taking an MBA at Stanford. . . . **Paul White** is still at Stanford working on a PhD in applied physics.

Ken reports having heard from **Fintan Ryan,** who also just took a master's in physics and is in his fourth year of doing gravity theory at Caltech; and also from **Akikazu Hashimoto,** who is in a third year of string theory at Princeton. Akikazu visited Santa Barbara and the Bay Area for part of the summer. . . . **Miriam Lawler** was recently engaged to Jeff Gilkinson (Cornell, '95). They plan to get married in Kansas City next summer (on June 14, 1997). . . . **Mark Enstrom** has moved once again. Same company, same e-mail address <enstrom@ttc.com>, different coast. He has recently taken a product marketing position and joins Zvonimir Turcinov, '95, at headquarters for TTC in Germantown, Md. If you're in the D.C. area, e-mail him.

Andy Howe took his profits from his kennel and recently purchased two old farm horses and a carriage. He will give scenic carriage rides through Concord, Mass. Look for his stable, "Road Apple Carriages," on Lyre St, just south of downtown Concord. He has also been hired as a studio singer at Fort Apache in Cambridge and has recorded tracks for The Mighty Mighty Bosstones, Squid, Salmon, and other fishy bands. Despite all this, he plans to move to Vancouver, B.C., within the next year, to further his sled racing goals. . . . **Jae Roh** is finishing a master's in technology and policy, where he's been doing a study of how a classroom in Lexington, Mass., is using the Web. He will be staying in Cambridge, and will finally leave MIT this fall to start at Mathworks in Natick as a user-interface designer. . . . **Jim Lee** is enjoying spending his summer in Los Angeles and Houston, working for McKinsey & Co. He recently saw **Eric Ask** and Neelan Choksi, '92, both of whom will be joining Jim, **Amy Chiang,** and Jeff Meyer, '90, at the University of Chicago Graduate School of Business. . . . **Karl Koschnitzke** is still in Phoenix working as a shop supervisor at an Allied Signal Aerospace machine shop. On weekends, he drives a front engine fuel dragster for Schroeder Motorsports on the nostalgic drag racing circuit. He was recently up in Seattle and saw ATO fraternity brother **John Abbamondi,** who's stationed at the Naval Whidby Island Airbase with an A-6 squadron.

In June, a group of MIT students and alumni edged out 14 local teams to win the Boston Dragon Boat Festival Races. As a result, they will represent Boston in the National Dragon Boat Championships in N.Y. in mid August. In preparation for the N.Y. race, the team competed in the Montreal International Dragon Boat Races and placed third overall. The team members include: **Kenway Louie, Otway Louie, Sean Wang, Ray Chun,** MungJin Im, '92, Yueh Lee, '95, Nate Crosswhite, '95, Tobi Ayer, '96, Perry Tsao, '97, Jeanne Yu, '97, Phil Huang, '99, Vern Shrauger, 'G, and Gene Van Buren, 'G.

Jonathan Li was in Hong Kong to represent the U.S. in the 20th Annual International Hong Kong Dragon Boat Championships. While there, he visited **Lisa Chow,** who is currently an active player in many Asian economies. Jonathan also ran into Kenway and Otway Louie while waiting in customs to return to Hong Kong from a visit to Macau. In mid August, Jonathan will also compete in the National Dragon Boat Championships but against fellow classmates who won the Boston races.

Jong Lee is currently working for Apple's Imaging Division as a mechanical engineer for ink jet printer products in Santa Clara. His e-mail address is <j.lee@apple.com>. There aren't too many MITers at Apple, but Jong did meet up with **Steve Ko** for lunch. . . . Rumors are that **Franklin Ko** got married in December, according to **Chris Tung.** Chris is working for Unisys. . . . **Tina Milano** is getting married in September, while **Shin John Choi** got hitched this past July in Florida. . . . **Wilber Su** is still at Tufts Med and driving his red 'Vette. . . . **Evren Unver** has quit his job at Andersen Consulting in Boston to go to business school at INSEAD, in Fontainebleu, France. Classes start in January, and in the meantime he will be spending time in Turkey and Greece. . . . **Paul Greenberg** just finished the MIT TPP program and is looking for a job. He is considering opportunities in the

States, back home in Canada, and in Europe. He is spending the summer in Boston, continuing to play jazz piano at Berklee.

Matthew Warren, Dave Lippe, and **Shayne Gary** vacationed in the Greek islands, after which Dave and Matt continued through Italy, Switzerland, and the Netherlands. Dave is at Berkeley for a PhD in mathematics; Shayne is getting a PhD from the London Business School; and Matthew is leaving a research position at Beth Israel Hospital to begin medical school. . . . **Brian Rosenberg** spent 10 days in Panama visiting Jennifer Rogers, then 10 days in Maui, Hawaii, for the Optical Society of America's summer topical conferences. Brian presented a poster at the Adaptive Optics session. He also served as best man at the wedding of Jeremy Hylton ('94), where he ran into Garlen Leung, '94, and Sarah Keightley, '94. . . . **Jim Haid** is currently working in northern Germany as a member of the General Electric audit staff. He will most likely be there until September. Next destination is unknown. . . . **Stacey Reeves** got married July 6 to Dan Diana. Among the many MITers attending were **Carrie Huguenin, Claude Denton, Carrie Allen, Monica Dodds,** Michele Sequeiro, '89, Mike Westphal, '90, **Kerry (Forbes) Hanault,** Mark Hanault, '90, **Jen Philhower, Chance Harris,** Wendy (Russel) Fedderly, '94, and Josh Fedderly, '94. Stacy has promised to send a picture to *Tech Review* as soon as she figures out whose camera they took it on.

Please send news for this column to: **Mari Madsen,** secretary, 26 John St. #3, Brookline, MA 02146; e-mail: <mmadsen@opal.tufts.edu>

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Please send news for this column to: **Jeff Van Dyke,** secretary, 6000 Shepherd Mountain Cove #1401, Austin, TX 78730; e-mail: <jvandyke@trilogy.com>

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For those of you who are moving to new addresses, there are a few things you should do. Call or write the Alumni/ae Records office: Building 12-090, 77 Mass. Ave, Cambridge, MA 02139, (617) 253-8270; send e-mail to <mitalum@mitvmc.mit.edu>; or go to the alumni/ae Web page and complete the on-line address change form <http://web.mit.edu/alum/www/>. Make sure we have your current address on file! When an address is changed, it takes care of everything related to the Alumni/ae Association (*Technology Review*, club mailings, and probably department mailings, too). It does not, however, change the address with other MIT offices (i.e. Bursar, Registrar). If there are any offices like this that would need to know where you are, you should send your new address to them directly. Another small business note—those of you who are members-at-large of our class council, please get in touch with me as soon as possible! You can send e-mail or snail mail or phone. See bottom of this column.

Stan Thompson will be joining the staff of the *Southern California Law Review* and has accepted an offer for a summer associate position in the Los Angeles office of Graham & James law firm for next year. Also in Southern California is **Yong Joo,** who finished a degree in June. . . . **Ivan Oei** graduated with an MNG in EECS in June and took it easy at home in LA for a while. He was planning to go to Europe for three weeks in July with **Raj Sarkar,** who also got an MNG in EECS in June. Ivan will be working at Qualcomm, Inc., in San Diego in September. . . . **Gus Leotta** is in San Francisco going to med school at UC/SF. This summer he did research in hand surgery and is enjoying the beautiful weekends in Northern California. He went to the wedding of D.C. Seward, '93, wedding in Sunnyvale, Calif. . . . **Kristen Lohman** graduated from Stanford in June with a master's in environmental fluid mechanics and hydrology. On August 1, she started working for AER in San Ramon, Calif., an environmental company that specializes in atmospheric and water studies.

Also at Stanford, **Julie Ngau** is in the materials science and engineering PhD program. She has recently begun working on modeling the process physics of SiGe in the electrical engineering department. . . . **Dave Lee** is at Stanford pursuing a masters in industrial engineering. . . . **Jon Michelson** finished a Course VI MNG then moved to Mountain View, Calif., and began working at Silicon Graphics. . . . **Eugene Lin** starts work at Microsoft on August 19 and (in the beginning of August) was planning to drive to Seattle with Joanna Law, '98.

Working our way East, **Pedro Herrera** is working for KLA instruments in Austin, Tex., and **Jennifer Reyna** is at Rice University for a PhD in chemistry. . . . **Judy Gagnon** joined Teach For America, a national teachers corps. She will be teaching high school math in south Louisiana and dancing up a storm at the many festivals and Cajun dances that Louisiana is so famous for! . . . **Astrid Richter** finished a master's in mechanical engineering at the 'Tute (her specialty was new product development). On July 1, she went back to the Timken Co. in Ohio and got to live with her husband after six months of separation! She is working in the customer engineering department, where, along with sales engineers and customers, she'll be calculating solutions for various tapered roller bearing applications.

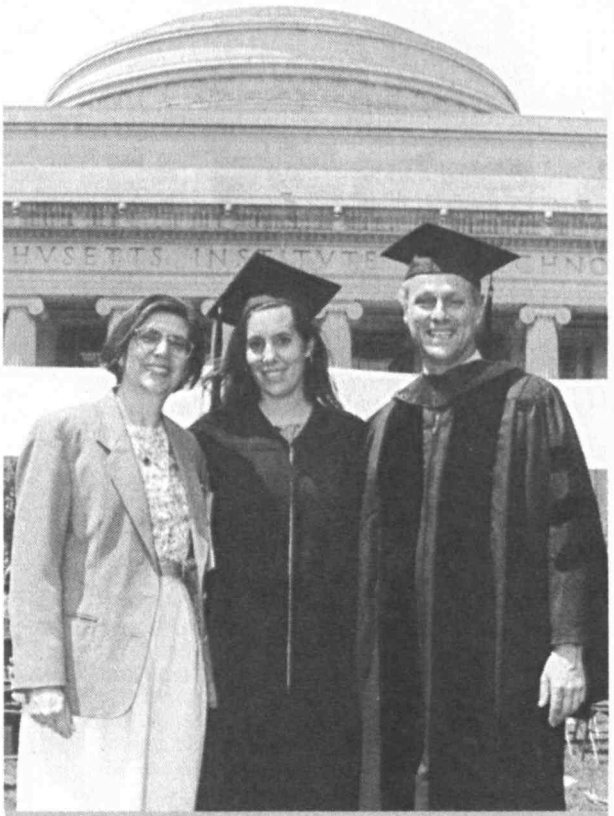
Congratulations to **Kelly (David) Inman** —on June 8, 1996, he married Jill Rainbolt in his hometown of Claremore, Okla. Eric Randall, '94, was a groomsman. Kelly is currently working for Hallmark Cards, Inc., as a process improvement engineer. . . . **Raj Prabhakar** has spent an exciting year in mergers and acquisitions at Wasserstein Perella & Co. in New York City. . . . **Jesse Hull** is working for Agents, Inc., a small startup located in Central Square, and **Andrew Kim** is in the Course III PhD program at MIT. . . . After spending the past year at Toshiba in Japan, **Arun Thomas** is back in Cambridge starting an MNG in Course VI.

Let me know what you and your friends are up to. Best wishes for a great holiday season and a terrific new year! (Seems odd to be mentioning this since I'm writing this column in August!) Send news to: **Ranjini Srikantiah,** secretary, IDX Systems Corp., 116 Huntington Ave, Flr. 13, Boston, MA 02116; e-mail: <srikantiah@idx.com>

ClassNotes

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Congratulations, graduates! Hard to believe there's a life after MIT, but I'd like to hear all about it so that I can fill this column before the next copy deadline. Please send your news (and photos) to **Surekha Vajjhala,** secretary, 9461 Hundred Drums Row, Columbia, MD 21046



Jennifer Rosenfield, '96, was the real maverick in her family; she chose an undergraduate major in biology, rather than taking an SB in mathematics, like her parents. Both Nancy and Donald Rosenfield received their bachelor's degrees in 1971, the year when Don—now a senior lecturer in the Sloan School—also received a master's degree in operations research and an engineer's degree in electrical engineering. Nancy marched with the 25th Reunion Class and Don marched with the faculty, making the Commencement procession a Rosenfield family affair.

PHOTO: DONNA COVENEY/MIT NEWS OFFICE

Puzzle

Continued from Page MIT 55

found it best to arrange the free squares first. For example, when N=4 the free squares can be placed anywhere on the board. When placed on the edge, there are six squares available to place the 4 queens. In cases of N>6 I arranged the position of the queens first. I started by placing the queens in a compact group in one corner of the board. I selected the corner since then I had only one diagonal width of the group to minimize while I was also attempting to minimize the row and column widths of the group. Tight packing of the queens assured that certain squares would be attacked many times while leaving others free. As each queen attacks 3N-2+2E squares, where E is the distance in squares of the queen from the edge squares of the board, a few widely distributed queens can attack large numbers of squares. Five queens, properly placed, can attack every square of a N=11 board. Upon examining my placement of queens in the corner, I found, in some cases, their grouping could be made improved by relocating certain queens on the edge of the group so the group would have a slimmer appearance viewed along a row, column, or long diagonal of the group.

Solutions for July

Jul 1. In the hand below, submitted by Doug Van Patter, the bidding was short and sweet: South opened with 1H, West bid 2C, North bid 4H, and everyone then passed. How can South make the contract after opening lead of the King of Clubs?

North
♠ J 8 6
♥ K 7 4
♦ K Q 10
♣ A 10 9 8

West	East
♠ K 10 3	♠ Q 7 5 4 2
♥ 10 3	♥ 9 8
♦ 8 4	♦ A J 7 6 5
♣ K Q J 7 5 2	♣ 3

South
♠ A 9
♥ A Q J 6 5 2
♦ 9 3 2
♣ 6 4

The solution to the problem lies in establishing a club as the 10th trick.

North wins the 1st trick with CA. South wins the next two tricks with HA and HQ leaving HK in the dummy. On trick-4, South plays its last club and losing to West's CJ (North plays C8).

If West leads a spade on trick-5, South wins with SA, crosses over to North's HK and discards S9 on North's C9 losing to West's CQ. South then concedes North's DK to East's DA, and uses North's DQ as the entry to use the now good CT for a diamond discard.

If West leads a diamond on trick-5, North plays DK:

- If East wins with DA and returns a spade (best), South wins with SA. North's HK is then used as the entry to discard South's S9 on North's C9. North's established CT is then used for a diamond discard using DQ as the entry.
- If East refuses to win trick-5 with DA, North then plays C9 and South discards a diamond on trick-6. The defense will get one more trick in diamonds. South's losing S9 will be discarded on North's CT using HK as the entry.

In all cases, N-S loses 2 club tricks and one diamond trick.

Jul 2. Phil Bonomo seems to like "space cadet" problems, especially those involving navigation satellites. In '93 he asked about their velocity, now he questions their altitude.

Geosynchronous orbits are generally taken to be the orbits of largest radius (highest altitude) for earth-orbiting spacecraft. These circular orbits, of radius R_s (≈26,300 miles), are characterized by a 24-hour orbital period and are typically used by the equatorial, "stationary" class of communications spacecraft. Another class of communications spacecraft (the Russian "Molniya" class) employ inclined, highly eccentric orbits characterized by a 12-hour orbital period.

For what orbital conditions, if any, is the largest (apogee) radius of a Molniya orbit greater than the synchronous orbital radius R_s?

The solution below is from Andrew Mazzella. Note that it satisfies the constraint that the perigee radius must exceed the earth's radius. John Prussing, a professor of aero and astro at Illinois, tells me that this constraint "is a prime recommendation of NASA."

By Kepler's Law: $\left(\frac{R_s}{R_M}\right)^3 = \left(\frac{T_s}{T_M}\right)^2$

where

R_s=geosynchronous orbital radius

R_M=Molniya orbit semi-major axis

T_s=geosynchronous orbital period (24 hours)

T_M=Molniya orbital period (12 hours)

Therefore

$$\left(\frac{R_s}{R_M}\right)^3 = \left(\frac{T_s}{T_M}\right)^2 \quad \text{or} \quad R_M = R_s\left(\frac{T_M}{T_s}\right)^{\frac{2}{3}} = \frac{R_s}{4^{\frac{1}{3}}}$$

giving (approximately)

$$R_M = 16570 \text{ miles}$$

For a Molniya apogee greater than the geosynchronous orbital radius, the Molniya orbit eccentricity (e) must satisfy: $R_M\cdot(1+e)>R_s$ or $1+e>4^{1/3}$

giving (approximately)

$$e>0.587$$

However, to be an allowable orbit, perigee must be greater than the radius of the earth (R_e)(and should exceed it by a reasonable margin to allow for the atmosphere), so:

$$R_M\cdot(1-e)>R_e$$

where

$R_M\cdot(1-e)=16570 \text{ miles}(1-0.587)=6843 \text{ miles}$

and $R_e=3995$ miles

so this orbit is attainable.

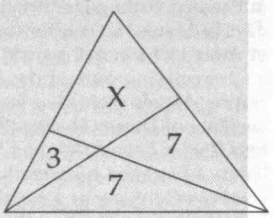
Allowing 100 miles for atmosphere, the limiting eccentricity for a feasible orbit is given by:

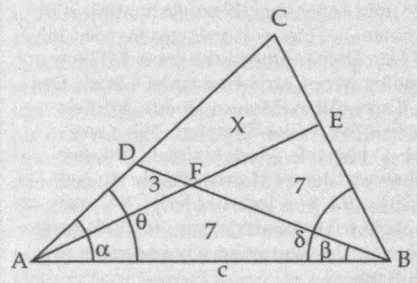
$$R_M(1-e_x)= R_a \quad \text{or} \quad e_x=1-\frac{R_a}{R_M}$$

giving

$$e_x=1-\frac{4055 \text{ miles}}{16570 \text{ miles}}=0.755$$

Jul 3. Nob Yoshigahara wants you to figure out the area of X in the figure below. An embarrassment of riches: I received a number of beautifully drawn solutions, all of which deserved publication. After some thought I decided on Kenneth Bernstein's.





Label the figure as shown. The length of AB is c. The altitude from D in triangle ABD is $c/(\cot\theta + \cot\beta)$; the altitude from F in triangle ABF is $c/(\cot\alpha + \cot\beta)$; and the altitude from E in triangle ABE is $c/(\cot\alpha + \cot\delta)$. Calculating the areas of the triangles:

ABD: $c^2 = 20(\cot\theta + \cot\beta)$;

ABF: $c^2 = 14(\cot\alpha + \cot\beta)$;

ABE: $c^2 = 28(\cot\alpha + \cot\delta)$.

From these equations we have:

$\cot\beta = (5/2)\cot\theta + (7/2)\cot\delta$; and

$\cot\alpha = (5/2)\cot\theta + (3/2)\cot\delta$.

Finally, from triangle ABC: $34 + 2X = c^2/(\cot\theta+\cot\delta) = 14(5\cot\theta+5\cot\delta)/(\cot\theta+\cot\delta) = 70$, or $X = 18$.

Other Responders

Responses have also been received from D. Alexander, C. Bahne, R. Bart, A. Beris, G. Blondin, J. Bush, X. Dai, E. Dawson, D. Detlefs, R. Dreselly, B. Durie, M. Egerton, E. Field, M. Fineman, M. Fountain, J. Grossman, J. Harmse, R. Hess, S. Hsu, P. Jung, L. Krakauer, J. Kusters, M. Lindenberg, G. Lum, N. Markovitz, D. Marron, J. Miller, C. Muehe, A. Peralta, J. Prussing, C. Rife, K. Rosato, E. Sard, L. Schaider, R. Scheidenhelm, E. Shung, R. Sinclair, N. Spencer, H. Stern, B. Thorburn, M. Veall, D. Wellington, J. Wright, and R. Yaseen.

Solution to Speed Problem

$f(x) = g(x)-x$ where $g(x)$ is the number of LCD elements in x. [I was personally baffled by this answer until I realized that LCD does NOT mean least common denominator (think calculator)—ed.]

CourseNews

I CIVIL AND ENVIRONMENTAL ENGINEERING

Samer M. Madanat, SM '88, PhD '91, writes: "I have been promoted to associate professor and granted tenure at Purdue University." . . . **Udaya B. Halabe**, SM '88, SM '90 (XV), PhD '90, sends word from Morgantown, W. Va.: "I have been promoted to the rank of associate professor of civil and environmental engineering at West Virginia University. On May 30, my wife, Anjali, and I had our first child (daughter), Esha Halabe, who weighed 7 lbs. at birth."

Joel Wiesenfeld, SM '41, of Highland Park, N.J., died on December 5, 1995. Wiesenfeld, a professor at Rutgers University for 41 years, joined the university staff in 1946 and was promoted to professor of civil engineering in 1958. He was chairman of the Department of Civil Engineering for ten years and assistant dean of the College of Engineering for seven years. Earlier in his career, he worked for Curtiss-Wright Corp. in Buffalo, N.Y., from 1941 to 1945, and for Republic Aviation Corp. in Farmingdale, N.Y., from 1945 to 1946. Wiesenfeld served as superintendent of the Water and Sewer Department of Highland Park from 1961 to 1987, and chairman of the New Jersey State Uniform Construction Code Advisory Board from 1976 to 1995. He was the organizer of the Annual N.J. Asphalt Paving Conference and past president of the Highland Park Parent Teacher Association.

II MECHANICAL ENGINEERING

From Córdoba, Argentina, **Eduardo R. Abril**, SM '41, writes: "I have just finished my book entitled *A New Interpretation of the Physical and Chemical Phenomena*, which I will translate to English. The theory on which the book is based (compared with alternative theories) is explained in a short paper called "Science and Phylosofy," which will also be translated into English. . . . **Chester L. Nachtigal**, SM '66, ME '66, PhD '69, sends word from Seattle: "My company, Engineering Services and Systems, Inc., has received a very large contract for supplying conveyor-belt scales to a new aggregate plant." . . . MIT Professor **Carl R. Peterson**, SM '58, ScD '63, reports: "In July I became 'emeritus' with acceptance of an early retirement offer. I plan to keep a finger in the mechanical engineering department design pie and hope to continue working with NADET in the Energy Lab, in addition to NATO diasarmament (chemical weapons) activities." . . . **Patrick B. Usoro**, SM '77, ScD '80, principal research engineer at the General Motors R&D Center, was honored for "Outstanding Technical Contribution" at the 10th Annual Black Engineer of the Year Awards Banquet by Career Communications Group, Inc., a Baltimore-based company dedicated to diversity.

Michael Allen Lew, SM '69, of McLean, Va., died suddenly on June 17, 1995. Lew was on the technical staff at the Mitre Corp. . . . **Alf Hugo Bendixen**, SM '34, of Gainesville, Fla., died on January 1, 1995. No further information was provided.

III MATERIALS SCIENCE AND ENGINEERING

In 1995, **Gerald S. Frankel**, ScD '85, joined the Department of Materials Science and Engineering at Ohio State University as an associate professor and the director of the Fontana Corrosion Center. Previously, he spent nine years as research staff member at the IBM T.J. Watson Research Center in Yorktown Heights, N.Y. This past summer, a team of researchers led by Frankel was awarded a $5 million Multidisciplinary University Research Initiative from the Air Force Office of Scientific Research to study the mechanism of corrosion inhibition of aluminum alloys by chromates. He lives in Bexley, Ohio, with his wife, June, and daughters Dana, 10, and Sasha, 8. His e-mail address is <frankel.10@osu.edu>.

Craig Duncan Douglas, ScD '83, of Lexington, Mass., died on May 13, 1996. Douglas, an associate professor of mechanical engineering at UMass/Lowell, was an expert on fibrous reinforced composite materials and their applications in underwater vessels and spacecraft. In addition to teaching at UMass/Lowell since 1983, he was the owner of Douglas/AMECO, a private consulting and engineering company. An avid boater and underwater photographer, Douglas was a member of the Boston Sea Rovers, a scuba-diving club.

IV ARCHITECTURE

Todd L. Siler, SM '81, PhD '86, writes: "I founded a company in 1983, PSI-PHI Communications, which specializes in developing innovative multimedia learning materials and processes for fostering creative and critical thinking in business, education, and the home. My book, *Breaking the Mind Barrier* (Simon & Schuster, 1990), was nominated for the 1994 University of Louisville Grawemeyer Award in Education, for 'a work of outstanding educational achievement with potential for worldwide impact.' " . . . **William David Martin**, MAA '76, MCP '76 (XI), sends word: "I am principal in the Monterey, Calif., firm of William Martin, AIA & Associates, Architects & Planners. I recently won an American Concrete Award for unique use of concrete in a rammed-earth home in Salinas, Calif., and an award of merit from the American Institute of Architects Monterey Bay chapter for a home in Carmel, Calif. The latter house was featured in the November 1995 issue of *Sunset* magazine." . . . From San Luis Obispo, Calif., **Donna Duerk**, MAA '80, reports: "I am going on sabbatical in the fall to develop a multimedia presentation based upon my MIT thesis. My architectural programming text is in its second printing. I have become an avid scuba diver and love the sights in the cold California waters. Teaching continues to be an inspiration."

Albert F. Vallecillo, MAR '92, writes: "I am a development specialist with the Sacramento Mutual Housing Association, a nonprofit affordable-housing developer. I also am teaching in the environmental design department at UC/Davis as a lecturer/studio instructor in the interior architecture program. Along with maintaining a small practice, I coach AYSO

DEGREE CODES

AE	Aeronautical Engineer
BE	Building Engineer
CE	Civil Engineer
CHE	Chemical Engineer
CSE	Computer Science Engineer
DPH	Doctor of Public Health
EAA	Aeronautical & Astronautical Engineer
EE	Electrical Engineer
EGD	Doctor of Engineering
ENE	Environmental Engineer
MAA	Master in Architecture Advanced Studies
MAE	Materials Engineer
MAR	Master in Architecture
MCP	Master in City Planning
ME	Mechanical Engineer
MET	Meteorologist
MIE	Mineral Engineer
MME	Marine Mechanical Engineer
MNG	Master in Engineering
MPH	Master in Public Health
MTE	Metallurgical Engineer
NA	Naval Architect
NE	Naval Engineer
NUE	Nuclear Engineer
OCE	Ocean Engineer
PhD	Doctor in Philosophy
ScD	Doctor of Science
SE	Sanitary Engineer
SM	Master of Science



Send information for CourseNews to <mitalum@mitvmc.mit.edu>

soccer and Little League with my sons, and am enjoying myself and my family." . . . **Larry Vale**, SM '88, and his wife, Julie Dobrow, annouce the birth of thier third child, Jeremy Evan Dobrow Vale, on May 25, 1996. He joins Mira, 5, and brother Aaron, 3. Vale, who spent this year working on a book about Boston public housing funded by a Guggenheim Fellowship and a Graham Foundation grant, is an associate professor in the MIT Department of Urban Studies and Planning; Julie is the coordinator of Children and Media Initiatives at Tufts University, and on the faculties of the Department of Child Development and the Communications and Media Studies Program.

Kevin L. Landel, SM '88, writes: "Living and surfing in sunny San Diego, Calif. I was named CTO of Triad Interactive LLC, developing interactive television systems and content. I'm also the founder and principal engineer of the Media Technology Group. And I'm consulting internationally, most recently at the Sydney VisLab and the Australian Technology Park. Look for me at the Sydney 2000 Olympics! . . . **Leslie Norford** has been promoted to a Course IV associate professor with tenure. He came to MIT as an assistant professor in 1988, was promoted to associate professor in 1993, and was named the Thomas D. and Virginia W. Cabot Career Development Professor in 1995. His research focuses on monitoring and control of energy-efficient buildings, reducing the energy impact of new electronic office equipment, and developing and applying energy-effiecient building concepts to the developing world. Norford did the first in-depth monitoring of Russian building performance and is deeply involved in setting up rational energy standards for Russian housing. He has also established innovative joint educational and research activities between students in building technology and architectural design. . . . **Mitchel Resnick**, SM '88 (VI), PhD '92 (VI), has been promoted to associate professor without tenure in Course IV's Media Arts and Sciences.

The Association of Alumni and Alumnae has been notified of the following deaths: **Margaret Vredenburgh Van Vilas**, MAR '30, of Branford, Conn., on August, 13, 1995; **Robert Stanley Bryan**, MCP '51, of Fairfield, Conn., on April 16, 1996; **Richard Maxwell Horowitz**, MAR '55, of Moorestown, N.J., on October 22, 1995; and **Lawrence Scott Partridge**, MAR '60, of Birmingham, Ala., on February 24, 1995. Partridge was president of the Ritchie Organization, also in Birmingham. There was no further information provided.

V CHEMISTRY

Barbara V. Enagonio, PhD '50, writes: "I joined fellow alumni/ae on the Alumni/ae Travel Program Wilderness Tour in Alaska in July '96—my 'dream trip.' " . . . **Chi-Huey Wong**, PhD '82, sends word: "I am the Ernest W. Hahn Professor of Chemistry at the Scripps Research Institute and was elected a member of the American Academy of Arts and Sciences in 1996." . . . **Richard Mendelsohn**, PhD '72, reports: "I spent a productive sabbatical on leave from Rutgers at UC/Berkeley and a fabulous 50th birthday week on a rented barge/yacht on the River Saône in Burgundy. My daughter will graduate from Washington University next year and probably will pursue a literary career." . . . **Marion O'Leary**, PhD '66, director for the Center for Biological Chemistry at the University of Nebraska/Lincoln, has been named dean of the School of Natural Sciences and Mathematics at California State University, Sacramento (CSUS). The creation of this school is the result of a reorganization of the CSUS School of Arts and Sciences, the largest educational unit at the university. The new school will include the departments of biological sciences, chemistry, geography, geology, mathematics/statistics, physics/astronomy, and psychology. O'Leary is an active research scientist in the areas of chemistry, biochemistry, and plant physiology. His research has been supported by the NSF, the NIH, and the U.S. Departments of Agriculture and Energy. He has been awarded Guggenheim and Sloan Foundation Fellowships, and was an NIH fellow at Harvard University.

Gregory C. Fu, '85, assistant professor in MIT's Course V, is one of 18 young faculty members nationally to be named a Cottrell Scholar by the Research Corp., a private foundation in Tucson, Ariz. The honor, which carries a $50,000 award, recognizes new faculty members who wish to excel at both teaching and research." There were 112 applicants for the 1996 awards, which are considered among the most prestigious fellowships for beginning faculty in the sciences. They are named for Frederick G. Cottrell, a chemist who created the Research Corp. Fu's research interests focus on the development of new reagents and methods for organic chemistry, with an emphasis on asymmetric catalysis, and also the elucidation of reaction mechanisms. Fu serves as faculty advisor to ClubChem, an organization for chemistry majors that organizes social events for undergraduates and also runs an outreach program to elementary schools in the Boston. . . . **Moungi G. Bawendi** has been appointed a Course V full professor with tenure. After earning a PhD at the University of Chicago, Bawendi was a postdoctoral member of the technical staff at AT&T Bell Laboratories in Murray Hill from 1988 to 1990, when he joined the faculty as an assistant professor. Bawendi was promoted to associate professor in 1995. His research focuses on semiconductor nanocrystallite systems. Broadly defined, this probes the chemistry and physics of nearly monodisperse semiconductor nanocrystallites, so-called "quantum dots," isolated and in complex structures.

The Association of Alumni and Alumnae has been notified of the following deaths: **Algird Kreuchunas**, PhD '50, of Detroit, Mich., on April 15, 1996; and **Joseph Sherman Jones**, PhD '63, of Macungie, Pa., on April 8, 1996. Jones was a member of the technical staff at AT&T Bell Laboratories in Allentown, Pa. There was no further information provided.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Alan Eagle, '46, writes: "I am retired now after 30 years as executive in charge of information technology (MIS) at several Silicon Valley firms. My activities now include skiing, windsurfing, traveling, and managing investments to pay for all of the above." . . . **Martin Fuchs**, '76 , SM '86, reports: "I recently accepted a position as head of product development at Active Impulse Systems, a startup aiming to commercialize some technology coming out of MIT for thin-film characterization. My family is doing well—daughters Hannah and Sophie are 3 and 7." . . . Photographic Arts, a fine-art printer owned and operated by photographer **John Wawrzonek**, '63, SM '65, EE '69, has merged with EverColor Limited, a California maker of digitally imaged, pigment-transfer photographic prints. The new Worcester, Mass.-based company will be called EverColor Fine Art.



Charles Glass

Charles J. Glass, SM '54, retired from the U.S. Department of Transportation (DOT), National Highway Traffic Safety Administration (NHTSA), has been named a 1996 recipient of the American Society for Testing and Materials (ASTM) Award of Merit. The title of Fellow accompanies the award. Glass was nominated for the award by ASTM Committee F-30 on Emergency Medical Services. He was cited for outstanding service and sustained leadership in developing standards for F-30. Because of his active interest in EMS and the standards process, Glass was instrumental in formation of the process that eventually led to the creation of F-30. . . . **Gregory W. Wornell**, SM '87, PhD '91, has been named as the next holder of the Cecil and Ida Green Career Development Professorship. Wornell will hold the chair for three years. His principal fields of interest are signal processing and applications to wireless communications. Wornell is a principal investigator in the Digital Signal Processing Group of the Research Laboratory of Electronics. . . . **Mitchel Resnick**, SM '88, PhD '92, has been promoted to associate professor without tenure in Course IV's Media Arts and Sciences.

The Association of Alumni and Alumnae has been notified of the following deaths: **Joseph William Steiner**, SM '38, of Naples, Fla., on September 12, 1994; and **Harry E. Thomas**, SM '25, of Grosse Pointe, Mich., on April 22, 1996. There was no further information provided.

VI-A INTERNSHIP PROGRAM

Professor **Markus Zahn**, '67, SM '68, EE '69, ScD '70, VI-A director, is spending time this summer in France and Italy, meeting people in connection with his research interests and vacationing. **Lydia Wereminski** is taking her traditional month of August as vacation. **Virginia Pochetti**, of the former Lowell Institute School office under Director **Bruce D. Wedlock**, '56, SM '58, ScD '62, is filling in as VI-A secretary for August.

I say 'former Lowell Institute School' because MIT has decided not to house the School after this 93rd year of operation on campus. As of July 1, the school was welcomed



James L. Flanagan, SM '50, ScD '55 (third from left), and Institute Professor Emeritus Paul A. Samuelson (second from left) received the 1996 National Medal of Science from President Bill Clinton in July. Flanagan, director of the Center for Computer Aids for Industrial Productivity and VP for research at Rutgers University, was recognized "for contributions to speech communications research and for leadership in applications to telecommunications technology." He helped develop the technology for automatic speech recognition which enables, for example, a telephone recording to process human-voice instructions. Samuelson was honored "for fundamental contributions to economic science, specifically general equilibrium theory and macroeconomics, and to economic education and policy over a period of nearly 60 years."

by Northeastern University as a division of its School of Engineering Technology. Wedlock served as its director from 1973 until the transfer. He now occupies an office within our VI-A suite. His plans include some book revisions and teaching 6.071. As a VI-A grad (Bell Labs), VI-A faculty advisor, and longtime associate of mine, we welcome him back into the fold!

Faculty and staff who have taken advantage of the special retirement incentive are now beginning to actually terminate their affiliations with the Institute. For one who has been on board for 40 years, I see many gaps appearing through the departures of colleagues with whom I've been associated. Unfortunately many memories of MIT's history also depart with them. I wish them well in their retirement!

This spring one of our VI-A students, **Mario A. Yearwood**, received one of 28 prestigious Tau Beta Pi Fellowships. He will continue his graduate work in VI-A , which will lead to the MEng degree. Yearwood earned MIT's highest academic rating and was elected a member of MIT's Massachusetts Beta Chapter of Tau Beta Pi.

Visiting MIT on business, **Denice D. Denton**, '82, SM '82, EE '63, PhD '87, stopped by. We congratulated her on her recent appointment as dean of engineering at the University of Washington in Seattle. Denton was previously a professor of electrical and computer engineering and chemistry at the University of Wisconsin/Madison.

Shazia Makhdumi, '91, SM '92, graduated from Stanford and started work at Netscape in August.

I sadly report the death of **Barnes W. Woodhall**, '85, SM '85, in San Francisco on May 27, 1996. I had visited Barnes when he was on VI-A with H-P during my directorship.

Since the last column, we've had the following visitors. **Dean R. Collins**, '58, SM '59, chief of the high-performance systems and services division of the National Institute of Standards & Technology in Gaithersburg, Md., told us that **George Berryman** (formerly of TI/Dallas where he and Collins coordinated VI-A for many years) is doing fine following his wife's death. **Oscar P. Manley**, '56, SM '57, PhD '60, is with the Department of Energy in Washington, D.C. **Melvin M. Weiner**, '55, SM '56, who came in to visit Professor **Hermann A. Haus**, ScD '54, told us that his oldest son is an assistant professor of organic chemistry at Armstrong State College in Georgia and his younger son is in his third year of a PhD program in political science at Princeton. By e-mail, **Steven L. Rohall**, '87, SM '88, told us of the birth of a son on June 24, 1996.—John A. Tucker, director (emeritus) and lecturer, VI-A Program, MIT, 77 Mass. Ave., Rm 38-473, Cambridge, MA 02139-4307; e-mail: <jat@fenchurch.mit.edu>.

CourseNews

VII BIOLOGY



Michael Kamarck

Michael E. Kamarck, PhD '79, has been named VP for process sciences in the biotechnology unit of the Bayer Pharmaceutical Division North America. Previously, he was director of process sciences at the West Haven, Conn., location. In his new position, Kamarck is responsible for developing processes for manufacturing genetically engineered protein drugs within the biotechnology unit of Bayer's pharmaceutical division in Berkeley, Calif. Kamarck joined the Bayer group in 1982 as a senior research scientist, the second employee under a Bayer AG-sponsored biotechnology venture formed under the the name Molecular Diagnostics. Since then he has held research positions under the Miles and Bayer names. . . . **Lewis A. Chodosh**, PhD '88, has been named a recipient of the Charles E. Culpeper Foundation Scholarship in Medical Science for 1996. Through this award, Chodosh will receive $100,000 a year for up to three years to fund his research at the University of Pennsylvania School of Medicine in Philadelphia, where he is currently an assistant professor of molecular and cellular engineering and medicine. According to a Culpeper Foundation news release, "Chodosh will study the role played by the breast- and ovarian-cancer-susceptibility gene, BRCA1, in the pathogenesis of breast cancer and in normal programs of differentiation and development by altering the expression of this gene in cellular and animal model systems."

Peter K. Sorger has been appointed the Howard S. and Linda B. Stern Career Development Professorship. Sorger, who joined the Course VII faculty in 1994, researches the process of chromosome segregation at the molecular level to determine how defects in these processes cause genomic instability, a common property of tumor cells. . . . Course VII's **Hazel L. Sive** has been promoted from assistant professor to associate professor without tenure.

VIII PHYSICS

J. Lambert Bear, PhD '60, writes: "After a 30-year career at the Knolls Atomic Power Laboratory, I retired from my position as manager

of nuclear design in 1994. Retirement is terrific. I am doing more downhill skiing (during the week is great), travel (Alaska, Costa Rica, Hawaii), and finding new volunteer activities (literacy, AARP tax-aide, etc.)." . . . **William T. Walter**, PhD '62, reports: "Since retiring from AIL Systems, I have devoted myself to full-time consulting. I'm president of Laser Consultant, Inc., specializing in environmental services, air monitoring as well as metal-vapor lasers." . . . **Shirley Jackson**, SM '68, PhD '73, head of the U.S. Nuclear Regulatory Commission, recently spoke at the biennial Council on Undergraduate Research conference. The conference, which was held at the North Carolina Central University, focused on the advancing research opportunities with industry and government and was attended by many professors from across the country. . . . **Russ Siegelman**, '84, has joined the venture capital firm of Kleiner Perkins Caufield & Byers (KPCB). Sigelman was formerly a VP of Microsoft Network (MSN), where he was responsible for leading the MSN group and subsequently growing the service to one million members. He was also responsible for launch of the Web magazaine, *Slate*, edited by former *New Republic* editor Michael Kinsley.

Toyoichi Tanaka, MIT professor of physics and founder of Gel Sciences, Inc., has received *Discover* magazine's first Editor's Choice Award for Emerging Technology. Tanaka was recognized for his innovative work with thermally responsive polymer gels that have the unique property of reverse-phase transition: the ability to change from a liquid state at room temperature to a solid state at body temperature. Tanaka's polymer gels can be used for a broad range of applications including environmental cleanup, consumer products, footwear, and medical and cosmetic products. He was chosen from a field of 4,000 nominations. **Jacqueline Hewitt** has been promoted to Course VIII associate professor with tenure. Hewitt was named assistant professor at MIT in 1989 and held the Class of 1948 Career Development Chair from 1992 to 1995. She was promoted to associate professor in 1995 and was selected as the Edgerton Award winner. A specialist in gravitational lenses, Hewitt has been part of the MIT-Princeton group that has discovered 5 of the 12 gravitational lenses that are now well established. She was responsible for the discovery of the first "Einstein Ring," an image that occurs when the lens is highly symmetric and nearly perfectly aligned with the source. Her use of lenses as probes of dark matter and cosmological parameters is at the forefront of the field.

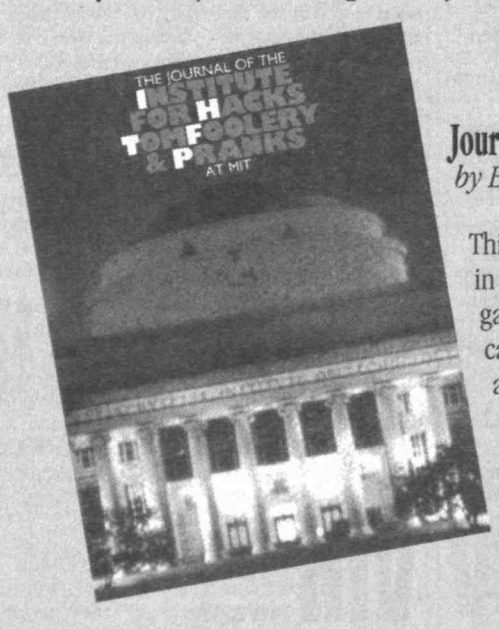
Xiao-Gang Wen has been promoted to Course VIII associate professor with tenure. Wen has been a member of the Institute for Theoretical Physics at the University of California and of the Institute for Advanced Study at Princeton. He joined the MIT faculty in 1991 and was promoted to associate professor in 1995. Wen is a theoretical condensed-matter physicist whose work on edge states in fractional quantum Hall systems is widely recognized. His recent research interests have been high Tc superconductors and strongly correlated and disordered systems. He is a recipient of the 1994 Outstanding Young Researcher Award.

John Herbert Wood, PhD '58, of Los Alamos, N. Mex., died on March 23, 1996. Wood was a staff member at Los Alamos National Lab. . . . The Association of Alumni and Alumnae has been notified that **Joseph Arthur Lovington**, SM '51, of Reedville, Va., died on November 6, 1995. There was no further information provided.

IX BRAIN AND COGNITIVE SCI-

William G. Quinn and **Hermann Steller** have been promoted to full professors with tenure in Course IX. Quinn was a postdoc at the California Institute of Technology and a faculty member at Princeton before he was was appointed an associate professor with tenure at MIT in 1984. Quinn, who has a joint appointment in the Department of Biology, is currently concentrating on the multiple processes underlying memory storage. Hermann Steller did postdoctoral research at UC/Berkeley in 1987 before joining the MIT faculty that year as an assistant professor. He became an associate professor in 1992 and was granted tenure in 1993. Since 1990, he has been a Howard Hughes Medical Institute associate investigator and an assistant neurobiologist at Massachusetts General Hospital. Steller, who also has a joint appointment in the Department of Biology, has expertise in molecular biology and neurobiology. His research focuses on the molecular basis of neural develop-

Hack \'hak\ ***n*** **1:** A prank, usually elaborate. ***v*** **1:** To perform a prank. **2:** To explore the places on campus that are not usually accessible. **3:** To work at or study a subject not especially for academic gain.



Journal of the Institute for Hacks, Tomfoolery, & Pranks at MIT
by Brian M. Leibowitz

This hilarious book recounts the history, folklore, and ingenuity of MIT students in their quest for the ultimate prank. From the famous Harvard-Yale football game to the Great Dome Pumpkin, this generously illustrated "journal" captures all the spirit and playfulness of the most hilarious tradition in academia. *Paperback, 158 pages,* $19.95

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ment in *Drosophila*, in particular the mechanism of axon guidance, neuron-target interactions, and programmed cell death.

X CHEMICAL ENGINEERING

Robert C. Armstrong has been appointed head of the MIT Department of Chemical Engineering, effective this past June. Armstrong, who joined MIT as an assistant professor in 1973 and has served as acting head (1993) and executive officer (1989) of the department, is noted for his research and teaching in polymer fluid mechanics, rheology, transport phenomena, and applied mathematics. He was responsible for the first systematic mapping of a flow transition diagram for complex flow of a polymeric liquid and the first accurate numerical method for computing the complex flow of polymer liquids.

James B. McNeely, SM '57, reports: "I have been with Astro Power, Inc., for 13 years. In that time Astro Power has grown from 2 employees to 144. We are one of the largest independent producers of solar (photovoltaic) cells and modules in the United States. I am manager of advanced optoelectronic products." . . . From Sperryville, Va., **Raymond R. Cwiklinski**, PhD '85, writes: "I am involved in chemical process design, analysis, simulation; special coatings development; special laser and radar systems development; and electrochemistry development. My hobby is raising cattle."

The Association of Alumni and Alumnae has been notified of the following deaths: **Francis Lee Shackelford**, SM '40, of New York, N.Y., on March 29, 1995; **Horace Irvin Etchells**, SM '36, of Orlando, Fla., on October 1, 1995; and **Alexander Sandor Borsanyi**, '59, of Newport Beach, Calif., on October 16, 1995. Borsanyi was a senior engineer at Baxter Healthcare Corp. in Irvine, Calif. No further details were provided.

X-A PRACTICE SCHOOL

It's the mid-summer doldrums in Cambridge—only a trickle of mail. But we missed last month (no news), so here's a quick report.

R. Douglas Hulse, SM '66, SM '68 (XV), is now COO of HemispheRx Biopharma, Inc., in Philadelphia. He's also executive director of the Safe Group, a Philadelphia-based, health-care consulting firm that specializes in biotechnology business development and strategic planning. HemispheRx's "platform technology" is designed to deal with viral diseases such as HIV and chronic fatigue syndrome. . . . A new honor for **Ralph Landau**, ScD '41: membership in the American Philosophical Society, which calls itself "the oldest and most prestigious learned society in the U.S. devoted to the advancement of scientific and scholarly inquiry." Landau may well be the first SCEP graduate thus honored. Does anyone know?

Proud father **Herbert Kay**, SM '47, sends news of his daughter, Diana Darcy Kay, SM '85 (XV), named associate director of business development in Pfizer's Spanish operations in Madrid. But Herb, retired in upstate Connecticut, tells us nothing about his own interest and activities. Maybe next month, when we hope more of you will have turned the mailbag from a dribble into a surge. Send word of your activities to either: Carol Phillips in the SCEP office, MIT, Room 66-309, MIT, Cambridge, MA 02139, <carol@pracschool.mit.edu> or the undersigned at *Technology Review*, address as below, or fax (617) 258-7886.—John Mattill, Room W59-200, MIT, Cambridge, MA 02139.

XI URBAN STUDIES AND PLANNING

William David Martin, MCP '76, MAA '76 (IV), sends word: "I am principal in the Monterey, Calif., firm of William Martin, AIA & Associates, architects and planners. I recently won an American Concrete Award for unique use of concrete in a rammed-earth home in Salinas, Calif., and an award of merit from the American Institute of Architects' Monterey Bay chapter for a home in Carmel, Calif. The latter house was covered in the November 1995 issue of *Sunset* magazine." . . . **Eugene D. Cizek**, MCP '66, sends news from New Orleans, La.: he was elected to the American Institute of Architects College of Fellows and received the AIA Honor Award for the restoration of Destrehan Plantation and the Vieux Carré Commission Award of Merit for Sindos-La torré-Boucvalt House. His students' work in the Education through Historic Preservation Program was honored by an exhibition at the Louisiana State Museum. He received three matching grants totaling $36,000 for an Historic American Buildings Survey covering a number of buildings on the National Register of Historic Landmarks.

Larry Vale, SM '88, and his wife, Julie Dobrow, annouce the birth of their third child, Jeremy Evan Dobrow Vale, on May 25, 1996. He joins Mira, 5, and brother Aaron, 3. Vale, who spent this year working on a book about Boston public housing funded by a Guggenheim Fellowship and a Graham Foundation grant, is an associate professor in the MIT Department of Urban Studies and Planning; Julie is the coordinator of Children and Media Initiatives at Tufts University and on the faculties of the Department of Child Development and the Communications and Media Studies Program. . . . **Barbara Fenner**, '79, reports: "I am executive director of West Greenville Community Development Corp. in Greenville, N.C., a nonprofit agency providing services in the following areas: 'affordable housing,' small business development, youth development, educational advocacy, and cultural enrichment to improve the quality of life for families in a low-income neighborhood in a city of 50,000."

Joanne Scott, '91, writes: "I am program coordinator for Seattle Team for You, a case management, law enforcement model for gang prevention and intervention. I'm also a founder of the Sisters in Common organization, a volunteer (nonprofit) group of women of color working with young women in the juvenile justice system."

The Association of Alumni and Alumnae has been notified of the following deaths:

CourseNews

James Ronald Jones, SM '53, of South Easton, Mass., on August 16, 1995; and **Madhu Valluri**, '87, of Bombay, India, on December 14, 1994, of leukemia. No further information was provided.

XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Francis E. Courtney, Jr., SM '52, writes: "I completed 50 years of professional meteorological work in June of 1994. To my knowledge, I am the only person who graduated in 1952 and became a certified consulting meteorologist." . . . **William "Billy" Spitzer**, PhD '89, has been appointed associate director of education at the New England Aquarium in Boston. Spitzer, a Boston-area educator, researcher, and author, oversees the aquarium's education initiatives, including interpretation and programs for visitors, curriculum development, teacher training, publications, and a variety of outreach programs to classrooms, hospitals, and local events. Spitzer's previous work experiences include the past seven years at TERC, an educational R&D firm in Cambridge.

Robert Beardsley, '64 (VIII), PhD '68, is the first recipient of the Walter A. and Hope Noyes Smith Chair at Woods Hole Oceanographic Institute. This permanently endowed rotating chair, one of three new endowed senior scientist chairs, was awarded for extraordinary accomplishment in marine scientific research and education. Beardsley was recognized for his research on coastal ocean processes. He was on the oceanography faculty at MIT from 1968 until 1975. Beardsley joined the WHOI staff in 1975 as an associate scientist and was promoted to senior scientist in 1981. He was chairman of the institution's Physical Oceanography Department from 1985 to 1990, and served as director of the Coastal Research Center from 1992 to 1995 . . . **Samuel A. Bowring** has been promoted to Course XII associate professor with tenure. Bowring taught at Washington Univeristy in St. Louis from 1984 to 1990, when he was appointed associate professor at MIT. Bowring is a geochemist who uses radiogenic isotopic techniques to address a variety of geological problems ranging from the early history of the continents to biological evolution. His isotope laboratory has been responsible for major advances in three distinct areas: 1) determining the duration and rate of the Cambrian explosion; 2) determining the age and geological history of the oldest continental crust on Earth, the 4-billion-year-old Acasta gneisses; and 3) integrating high-precision geochronology, thermochronology, and isotope tracer studies to understand the assembly and maturation of continental lithosphere.

The Association of Alumni and Alumnae has been notified that **Gurdon Montague Butler**, ScD '38, of Coronado, Calif., died on January 4, 1996. No further information was provided.



ALAN MULALLY, SM '82, VP for airplane development and definition and leader of the engineering division at Boeing Commercial Airplane Group, was named 1996 Engineer of the Year by Design News *magazine. Mulally, best known for his leadership in producing Boeing's new 777 twin-jet, was honored at a dinner in March during the International Design Engineering Show in Chicago. His "working together" approach is featured in* Leading People: Transforming Business from the Inside Out *by Paul Rosen (Viking). Rosen writes that Mulally "inspires and enables people to take responsibility and ownership." He abandoned the "old baggage of believing that power should be centralized in one person" but still "maintains leadership roles of vision, initiative, and accountability."*



XIII OCEAN ENGINEERING

Navy Commander **Sean J. Stackley**, SM '86 (II), OCE '86, recently reported for duty as project manager of Naval Sea Systems Command, in Arlington, Va. . . . **Robert Bird**, NE '49, was profiled in the *Syracuse Herald-Journal* (July 8, 1996), where he detailed his experiences while on an MIT-sponsored trip to Antarctica. The hearty 27-person expedition included two 88-year-old women and had an average participant age of 70. Bird's most memorable highlight was watching a fellow traveler sip 10-year-old scotch over a chip of blue, 10-million-year-old ice at the actual barbershop-style South Pole. Eileen, his wife of 53 years, opted out of this trip, though she plans to join him this winter on a return trip.

The Association of Alumni and Alumnae has been notified of the following deaths: Captain **Herbert John Hiemenz**, SM '34, of Newport News, Va., on May 14, 1994; and Rear Admiral **George Cameron Seay**, SM '40, of Sarasota, Fla., in September 1992. No further information was provided.

XIV ECONOMICS

See page 39 for information on Institute Professor Emeritus Paul A. Samuelson.

The Association of Alumni and Alumnae has been notified that **Lester Joseph Grant**, SM '50, of Bedford, N.H., died on June 2, 1993. Grant was a VP at Pilgrim Management Corp. in Boston. No further information was provided.

XV MANAGEMENT

Udaya B. Halabe, SM '88 (I), SM '90, PhD '90 (I), sends word from Morgantown, W. Va.: "I was promoted to the rank of associate professor of civil and environmental engineering at West Virginia University effective August 16. On May 30, my wife, Anjali, and I had our first child (daughter), Esha Halabe, who weighed 7 lbs. at birth." . . . **Paul J. Puzzanghera**, SM '79, writes: "Our company, Legacy Technology, continues to grow. We've just moved our corporate headquarters to Burlington, Mass., to capitalize on the rapid growth in the on-line analytical processing and data warehousing markets. Although Sloan grads are hard to find, we are doing our part by hiring lots of bright MIT undergrads." . . . **Rosemarie R. Shield**, SM '86, reports: "John Shield, PhD '89 (X), and I continue to enjoy being at small high-tech companies in the San Francisco area. We're both having lots of fun parenting—Kathy turned 3 in April." . . . **Gia-Khanh Nguyen**, SM '93, is working in the market risk department at Paribas Capital Markets, Ltd., in Tokyo.

Carol Smith, SM '92, and **Rich Moore**, SM '92, send news in May: "Hi everyone! In case you didn't know, Rich and I got married October 1995 at Disney World and then went to Spain for our honeymoon. We're expecting a baby in August, Sloan class of '23, maybe? Come visit us in St. Louis." . . . **Jon Lee**, SM '92, writes: "I am now working in India, living in Bombay, but spending most of my life in airports and Delhi. The work is pretty interesting, the food is great, the beaches are fantastic, and the weather a lot warmer than in London. Unfortunately, Internet connections are hard to come by and are completely unreliable." . . . **Erika Williams**, SM '78, has been appointed president and CEO of Cincinnati Microwave, Inc. She had been the company's director since 1994. Williams has served as CEO of Systems Integrators, Inc., a company that designs, manufactures, markets, and services publishing systems to the newspaper industry, since March 1996 and COO from July 1995.

Last May, **Yvan Allaire**, PhD '73, was appointed executive VP for strategy and corporate affairs at Bombardier, Inc., in Montreal, Quebec. Allaire, a Fellow of the Royal Society of Canada and once upon a time a visiting professor at Sloan, was formerly the Bombardier Professor of Transnational Management and a consultant in Montreal. Bombardier has 40,000 employees and operations in nine countries in aerospace, mass transit equipment, and motorized consumer products. . . . **John A. Sullivan**, SM '84, has been elected to the board of directors of Farr Company in El Segundo, Calif. Sullivan recently joined Batchelder & Partners, Inc., a San Diego-based merger and acquisition advisory firm. Farr Company is a manufacturer of filtration products for engine, railroad, gas turbine, pollution control, and air conditioning applications.

Peter Senge, SM '72, PhD '78, director of Sloan's Center for Organizational Learning, held a seminar entitled "Creating a Learning Organization: Collaboration and Positive Change," last July in Dallas. The session was sponsored by the University of Texas at Arlington's Division of Continuing Education.

Three Sloan School faculty members who've been named associate professors with tenure: **Steven Eppinger**, '83, SM '84, ScD '88 (all II), **Wanda J. Orlikowski**, and **Jiang Wang**. Eppinger became an an assistant professor of management at Sloan in 1988 and was promoted to associate professor in 1993. His research is at the intersection of product development, engineering design, manufacturing technology, and operations management. Eppinger's research, textbook, and course development have changed the practice and teaching of product design. He has taught in MIT's International Motor Vehicle Program, the Leaders for Manufacturing Program, and the System Design and Management Program. Wanda Orlikowski joined the MIT faculty in 1989 as assistant professor of information technologies, and became the Gordon Y Billard Professor in 1994. Her work has made substantial contributions to the understanding of organizational change around information technology. Orlikowski has been extensively involved in the MIT Centers for Coordination Science and Information Systems Research. Jiang Wang joined the MIT faculty in 1990 as the Nanyang Technical University (NTU) Career Development Assistant Professor, became NTU Associate Professor in 1994, and was appointed Ford Foundation International Career Development Associate Professor in 1995. Wang is a specialist in the area of theoretical capital markets, where his writing is widely praised for its technical skill and applicability to real-world empirical testing.

The Association of Alumni and Alumnae has been informed of the following deaths:

William Oscar Schach, '50, of Pittsburgh, Pa., on April 13, 1996; **Harrie William Miley**, '40, of Penfield, N.Y., on May 5, 1992; and **Edward Adrian Mayne**, '52, of Guildford, England, on April 12, 1996. Schach was retired from Merrill Lynch & Co., Inc., and Miley was retired from General Motors, Corp. No further information was provided.

SLOAN FELLOWS

Robert P. Clagett, SM '67, writes: "I just finished chairing a five-year review of the Tax System Modernization of the IRS for the National Research Council and have testified before the House and Senate about our findings." . . . **Gary N. Pheley**, SM '89, reports: "I was appointed director of labor relations for North American operations at General Motors Corp. in June 1994." . . . **Bill Porter**, SM '67, sends news: "I was selected as 'Entrepreneur of the Year for Emerging Companies in Silicon Valley' by the *San Jose Business Journal* for conceiving and developing the country's first interactive stock trading company E*Trade Securities, Inc."



Ronald Andrews

Ronald A. Andrews, SM '76, has been appointed VP of the Lockheed Martin Advanced Technology Center (ATC) in Palo Alto, Calif. Andrews joins the Palo Alto facility after an 11-year tenure as general manager of Lockheed Martin Advanced Technology Laboratories in Camden, N.J. According to a Lockheed Martin news release, "While there, he directed four laboratories that research, develop, and integrate notional system concepts in artificial intelligence, distributed processing, embedded processing, and advanced hardware components. Applications embraced defense, government, civil, and commercial sectors, and included solutions in multisector fusion, rapid prototyping of signal processors, information security, and high-speed digital processing."

The board of trustees at Washington University in St. Louis has elected **Katherine B. Magrath**, SM '76, to a four-year term as trustee. Magrath is a partner and CIO of ValueQuest, Ltd., of Marblehead, Mass. During the mid- to late-1970s, Magrath was director of investments and pensions planning for United Brands. In 1980, she and her husband, Terry, founded ValueQuest. Today, the company has close to $450 million of equity under management. .

The Association of Alumni and Alumnae has been informed of the following deaths: **John Michael Duich**, SM '58, of Coral Springs, Fla., on April 17, 1996; and **John Eckles Crawford**, SM '76, of Jackson, Miss., on November 30, 1995. Duich was a retired Motorola executive and Crawford was a self-employed private investor in Brandon, Miss.

SENIOR EXECUTIVES

Mark Craig, '92, sends e-mail: "I am now deputy director of the NASA Stennis Space Center near New Orleans. Stennis is NASA's lead in both rocket propulsion testing and commercial remote sensing. All of the Space Shuttle's main liquid rocket engines are test fired at Stennis before delivery to Cape Canaveral for launch. Stennis is also home to 23 federal agencies, including the Naval Meterology and Oceanography Command, the Naval Research Laboratory, and the National Data Buoy Center." . . . Captain **George Galdorisi**, '91, reports via e-mail: "I recently completed command tours in command of USS *Cleveland* (LPD 7) and Amphibious Squadron Seven. I am now chief of staff for Cruiser-Destroyer Group Three, embarked on USS *Carl Vinson*, currently deployed to the Persian Gulf. In addition to my military duties, I have recently cowritten a monograph (with syndicated columnist Doug Bandow) entitled *The United States and the 1982 Law of the Sea Convention: The Cases Pro and Con.*

Walter J. Murphy, '89, of Fanwood, N.J., died on April 3, 1996. He was VP for human resources in the International Operations Division at AT&T Communications, Inc., in Morristown, N.J. Murphy was aboard the plane of executives traveling with U.S. Secretary of Commerce Ron Brown that crashed in Croatia. . . . The Association of Alumni and Alumnae has been informed of the following deaths: **Cuthbert C. Hurd**, '59, of Portola Valley, Calif., on May 22, 1996; and **David W. Swindells**, '81, of Abingdon, England, on March 17, 1996. No further information was provided.

MANAGEMENT OF TECHNOLOGY

Erika Williams, SM '78, was appointed president and CEO of Cincinnati Microwave, Inc., in June. . . . **Naoki Kato**, SM '91, is now working with NTT Electronics Technology Corp (NEL), a semiconductor manufacturing subsidiary of NTT. Her assignments include corporate strategy, business controlling, and intellectual property. . . . Felix Antonio and **Daisy Rivera-Almentero**, SM '93, have a new family member. On June 19, 1996, Felix Alexander, III, was born weighing 8lbs. and 6.8 oz. The family now resides in Newton, Conn., where they built a large home on three acres of land. Daisy is still working with Schein Pharmaceutical as director of pharmaceutical technical services.—MOT Program, MIT, Room E52-126, Cambridge, MA 02139; e-mail: <mitmot@sloan.mit.edu>

CourseNews

XVI AERONAUTICS AND ASTRONAUTICS

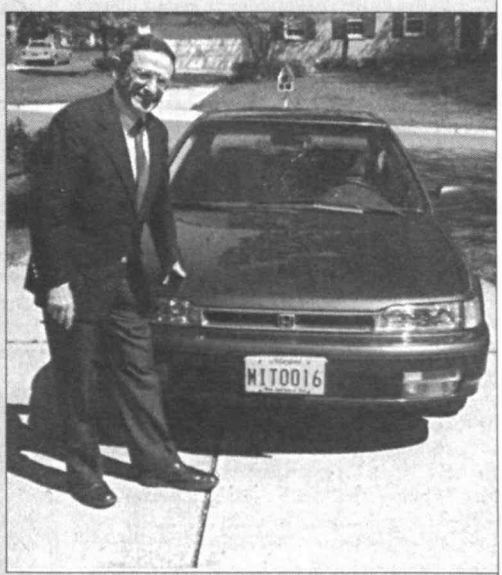


David Hyland

David C. Hyland, '69, SM '71, ScD '74, has been appointed chairman of the Department of Aerospace Engineering at the University of Michigan College of Engineering in Ann Arbor, Mich. Hyland was formerly senior scientist at Harris Corp.'s government aerospace systems division in Melbourne, Fla. Hyland's technical contributions for Harris Corp. include development of new methods for robust control design and analysis, co-invention of several new actuators, and invention in 1989 of a new neural network architecture for on-line system identification and adaptive control. He has served as principal investigator for numerous basic research programs for NASA and AFOSR. Before joining the Harris Corp., Hyland served on the technical staff of MIT's Lincoln Laboratory. . . . **Robert C. Stow**, SM '67, EAA '67, has been named VP for engineering at Marconi Electronic Systems, Inc., in Wayne, N.J. In 29 years with the company, he has had various executive positions, and was named company engineer of the year in 1985.

Edward F. Crawley, '76, SM '78, ScD '81, an

After the MIT Club of Washington, D.C., negotiated Institute-related affinity plates with the Maryland Department of Motor Vehicles, Robert Summers, SM '46, ScD '54, decided to commemorate Course XVI by choosing MIT0016. Summers also reports that after more than 27 years with the U.S. Arms Control and Disarmament Agency (ACDA), he has set up a consulting firm, Technology Systems International, in Potomac, Md. He plans to focus on defense-industry conversion in Russia and China, an area in which he specialized during his last four years with ACDA.



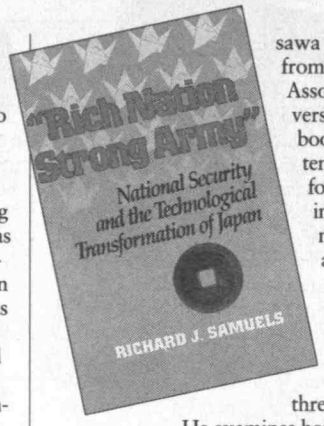
expert in the design, dynamics, and control of spacecraft and space structures, has been named head of the MIT Department of Aeronautics & Astronautics, his academic home since he came to MIT as a student in 1972. Crawley, highly regarded for his teaching as well as for his research, has been a MacVicar Faculty Fellow since 1992. He has directed the Space Engineering Research Center since 1986 and since 1994 he has been co-director of the Systems Design and Management Program. He is a Fellow of the American Institute of Aeronautics and Astronautics and was a member in 1993 of the Presidential Advisory Committee on the Space Station redesign. Not all of his interests aloft are in space, however. He is the New England Regional sailplane racing champion. An early and effective advocate of U.S.-Russian cooperation in space exploration, he was instrumental in 1989 in lifting the veil of secrecy from an important piece of space history. While on a visit to a Moscow museum with other MIT faculty members, Crawley saw, off to one side, a device that drew his attention. A sign, in Russian, with which he is conversant, said, "Luna Lander." It was, their host confirmed, the craft that the Russians had hoped would beat the United States to the moon. For years, the Soviets had denied "by silence and misinformation," as the *New York Times*' subsequent account of the revelation put it, that they had been racing America to be the first to land people on the moon. The MIT visitors were allowed to photograph the lander.

Shih I. Pai, SM '38, of Beltsville, Md., died on May 23, 1996. Pai was a retired aeronautical researcher at the University of Maryland who conducted pioneering studies focusing on the drag and lift of ever-faster airplanes, space engines, and missiles. His discoveries 40 years ago about the effects of structure on turbulent flow laid the foundation for him and fellow engineers to move from low-speed aerodynamics through high subsonic and on to supersonic and hypersonic speeds. As velocities increased dramatically—be it in aircraft, spacecraft, or rockets—shifting complexities arose in the interaction of electrical, chemical, and electromagnetic forces involved. Helping to define them, Pai published 14 textbooks and some 130 scientific papers about fluid and plasma dynamics. He was the founder of the Institute for Physical Science and Technology at the university's main campus in College Park, Md. Pai's professorial career began in Nanjing, but in 1947 he joined the faculty at Cornell Univeristy. He moved to the University of Maryland in 1953 and retired in 1983 as a professor emeritus.

The Association of Alumni and Alumnae has been informed of the following deaths: **Hua Lin**, ScD '55, '69 (XV-E), of Mercer Island, Wash., on October 4, 1995; and **Soumaila Doumbia**, SM '80, of Ivory Coast, in 1996. No further information was provided.

XVII POLITICAL SCIENCE

Rich Nation, Strong Army: National Security and the Technological Transformation of Japan by **Richard J. Samuels**, PhD '80, head of MIT Department of Political Science and director of the MIT Japan Program, has won the 1996 John Whitney Hall Book Prize of the Association of Asian Studies. The prize is awarded annually to an outstanding book on Japan or Korea on any topic in the humanities or social sciences. The book has also won the 1996 Ari-



sawa Memorial Prize from the American Association of University Presses. In the book, Samuels contends that Japan has focused on acquiring, diffusing, and nuturing an autonomous technological capabililty to achieve security in what it perceives to be a highly threatening world. He examines how Japan has embedded its defense industrial and technology base in its commercial industrial and technology base, not just to enhance its standard of living, but also to reduce its vulnerability to interruption of access to foreign technology. During his research for the book, Samuels received support from the Fulbright Foundation and the NSF. The book has been translated into Japanese and Korean.

Stephen D. Ansolabehere has been promoted to associate professor with tenure in Course XVII. Ansolabehere was appointed an assistant professor at MIT in 1993. He is a leader in the study of American national politics, focusing on political communications and voting behavior; in particular, he has made significant contributions to understanding the impact of advertising on voter participation. His research blending experimental and statistical analysis has shown that broadcast advertising has transformed the electorate, removing incentives for candidates to foster public-spiritedness and instead rewarding them for demobilizing large segments of the electorate. These conclusions form the basis of the book *Going Negative: How Political Advertisements Shrink and Polarize the Electorate*, which he cowrote.

XVIII MATHEMATICS

Millard W. Johnson, Jr., PhD '57, professor emeritus at the University of Wisconsin/Madison, has been named a Fellow of the ASME. Johnson is a member of the American Academy of Mechanics, the Society of Industrial and Applied Mathematics, and the Society of Rheology.

The Association of Alumni and Alumnae has been informed of the following deaths: **Abe Markham Gelbart**, PhD '40, of New York, N.Y., on September 7, 1994; **John Bertram Giever**, PhD '48, of Las Cruces, N.M., on February 24, 1994; and **Richard James Crittenden**, PhD '60, of Birmingham, Ala., on June 26, 1996. Giever was a professor in the math department at New Mexico State University, and Crittenden was affiliated with the math department at the University of Alabama at Birmingham. No further information was provided.

XX APPLIED BIOLOGICAL SCIENCES

NutraFeed, Inc., a subsidiary of of Organic Solutions, Inc., in San Antonio, Tex., has elected **William E. Pace**, SM '67, to their board of directors. Pace has recently retired from the Florida Department of Agriculture and Consumer Services where he held various positions including state veterinarian and director of the Division of Animal Industry. Pace also served in the Air Force, retiring in 1980 as colonel and as the deputy assistant surgeon general for Professional Services of the USAF.

XXI HUMANITIES

David B. Ralston has been promoted to full professor with tenure in the history section of Course XXI. Ralston was a history instructor at Columbia from 1958 to 1963 and at MIT in 1963–64. He became an assistant professor in 1964 and was promoted to associate professor in 1967. Ralston was a professor of strategy at the U.S. Naval War College on two occasions, and he also served as a visiting professor of history at the National University of Singapore. Ralston has published or edited four books, mainly concerned with the military history of modern Europe. His most recent work, *Importing the European Army*, is a comparative analysis of the impact of military reforms on countries outside of Europe, which attempted to copy the European military organization since the 17th century. He has taught survey courses on Western European history and on war, state, and society in the modern world.

XXII NUCLEAR ENGINEERING

William Julius Emrich, Jr., SM '74, writies: "I am currently working at NASA's Marshall Space Flight Center on a fusion propulsion experiment based upon a concept called the 'gasdynamic mirror.' The experiment is designed to test the confinement and stability characteristics of the plasma."

Jacquelyn C. Yanch has been promoted to associate professor with tenure in Course XXII. Yanch came to MIT as a postdoctoral associate in 1988, became an assistant professor in 1989, and was promoted to associate professor in 1993. She is the W.M. Keck Career Development Associate Professor in Nuclear Engineering at the Whitaker College of Health Sciences and Technology. Yanch's research has established her as a leading expert in neutronic and radiation transport simulation for development of new medical technology. Among her innovations has been boron neutron capture synovectomy to treat rheumatoid arthritis. Through collaboration with local industry, she has undertaken the design and assembly of the world's first compact, accelerator-based neutron source for boron neutron capture therapy. She has also made highly regarded contributions to synovectomy based in interstitial, electron-emitting isotopes and to interstitial X-ray therapy of brain tumors.

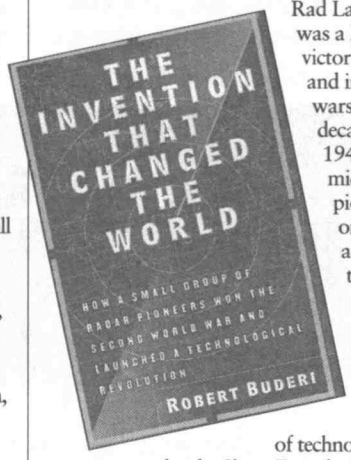
The Association of Alumni and Alumnae has been informed that **Robert Edward Donovan**, SM '68, of Fairfield, Conn., died on April 3, 1996. Donovan was president of ABB Asea Brown Boveri in Windsor, Conn. Donovan was aboard the plane of executives traveling with U.S. Secretary of Commerce Ron Brown that crashed in Croatia.

TPP TECHNOLOGY AND POLICY PROGRAM

Daryl Beardsley, SM '82, writes that he has close to 10 years of independent consulting experience, generally working with industries and/or government authorities worldwide to make manufacturing processes more materials efficient. As part of one project for sustainable industrial development in Costa Rica (on behalf of UNIDO), he spent several months evaluating the technical status of food-processing facilities, government and NGO programs, and structures for industry." Two of my policy recommendations to the government were actually implemented," he writes, "one to change an environmental statute and the other to reorganize an agency's approach to industrial regulation. My latest foreign mission took me to Kalimantan, Borneo, where I took boats up rivers to reach plywood facilities. And sometimes I go no further than Massachusetts." . . . **Greg Martin**, SM '88 (I, TPP), PhD '92 (I), moved from Ft. Lewis, Wash., to West Point, N.Y., in January 1995. He is now teaching in the Military Academy's Department of Social Sciences, which he says is really a department of politics, economics, and security studies. He teaches the core courses in international relations and American politics, as well as a senior elective in defense policy. . . . **Terry "Brad" Turnipseed**, SM '88 (XXII, TPP), graduated from Georgetown Law School in February 1996 and is currently employed with the law firm of Morgan, Lewis & Bockius. . . . **Francois Valraud**, SM '89, is a senior consultant with Microsoft France. . . . Susan, Jeremiah, and **Bertrand Rigaldies**, SM '90, are proud to announce the arrival of Julien Henri Gabriel on May 20, 1996. . . . Best wishes to Susan and **James "Jamie" Winebrake**, SM '90, who are expecting their third child in December. Jamie is an assistant professor in the Integrated Science and Technology Program at James Madison University. He reports that it is incredibly exciting to be in the formative years of what he believes will be a very successful program. . . . **Crispiniano "Cris" Acosta**, SM '91, has joined the staff of Metro Pacific Corp. as manager of the corporate development unit. . . . Karen and **Michael "Mick" Rookwood**, SM '92, are thrilled to announce the arrival of Molly on June 25, 1996. At 4 days old, Molly attended the wedding of **Seabron Adamson**, SM '92, and Ali Spray. Also in attendance were: **Richard Tabors, Chris Nielsen**, SM '92, Michael Goldstein, SM '92 (I, TPP), **Steve Downs**, SM '92, Gretchen and **Michael Sullivan**, SM '92, **Fuyuhiko "Fuyu" Nishimura**, SM '92 (VI, TPP), and **Rene Smith**. . . . **Masayo Fujimoto**, SM '93, started a PhD program at the Tokyo Institute of Technology with Professor **Kumiko Mizasaki**, who earned a PhD in Technology and Policy in Business from Sussex University, England. . . . **Hans Klein**, SM '93 (TPP), PhD '96 (XVII), the first doctorate in Technology, Management, and Policy, started as an assistant professor of public policy at Georgia Institute of Technology in Atlanta in September. . . . **Andrew Parris**, SM '93 (II, TPP), PhD '96 (II), stopped by TPP to let us know that he's traveling to Russia for the summer, following which he will return to Gordon College in Beverly, Mass., for a year. He then plans to return to Russia in an engineering position. . . . **Masatoshi Kano**, SM '94 (XV, TPP), is working with General Electric and Nippon Steel on first IPP (Independent Power Producer) in Japan, to be placed in Nagoya for Chubu Power. . . . Congratulations to **Leslie Liu**, '89, SM '94, and Ling Yi on the birth of their first child, Ethan Yi-Guang, on July 8. . . . **Takeshi Sugiyama**, SM '94, is responsible for for formulating strategies for five oil refineries in the head office of Showa Yokkaichi Sekiyu. Takeshi said he planned to move to Yokohama to be closer to work. . . . **Sanjay Kalpage**, SM '96, has joined the staff of Charles River Associates in Boston. . . . **Guillermo Peschard-Mijares**, '94 (II, XIV), SM '96 (II, TPP), is an associate with the Boston Consulting Group in Mexico. . . . **Christopher Stubbs**, SM '96 (I, TPP), is continuing at MIT in a PhD program in hydrology.

STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Robert Buderi, a 1986-87 MIT Knight Fellow in Science Journalism, recently published *The Invention That Changed the World: How a Small Group of Radar Pioneers Won the Second World War and Launched a Technological Revolution* (1996, Simon & Schuster, $30). "In a narrative that often reads as compellingly as the best spy fiction," wrote *Kirkus Reviews*, Buderi tells the story of the top-secret Atlantic crossing of a black box hiding a radar transmitter along with the British scientists who would work with their American counterparts in establishing the Radiation Laboratory at MIT. What ensued was "the wizard war," in Buderi's words, as Allied and German scientists raced to develop the most lethal tools and disarm the tools of the enemy.



The triumph of the Rad Lab scientists was a key to Allied victory in the air and in the U-boat wars, and in the decades after 1945, the microwave pioneers moved on to technical advances that transformed American life. This volume is the first in a series of books on the history of technology funded by the Sloan Foundation, and "if the rest of the series is like this," wrote the *Library Journal*, "readers will want to read them all."

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

Ralph Arthur Cartwright, '18; January 24, 1996; N. Hampton, N.H.
Carole Aaron Clarke, '21; May 24, 1996; Brielle, N.J.
Roy Dietrich Snyder, '21; May 26, 1996; Durham, N.C.
Hugh Dickson Nickle, '23; November 12, 1995; Seattle, Wash.
George Yeatman Anderson, '24; June 25, 1996; Milwaukee, Wis.
Jorge Adalberto Roig, '24; November 8, 1995; Humacao, P.R.
Warner Lumbard, '25; May 26, 1996; Madison, N.J.
George Fred Brousseau, '26; May 15, 1996; Braintree, Mass.
Nelson Frank Wilmot, '26; January 3, 1995
William Henry Richards, '27; December 18, 1995; Forestdale, Mass.
Jean Winifred Bennedsen, '28; July 1, 1996; Orinda, Calif.
Hall Livingstone Hibbard, '28; June 6, 1996; Los Angeles, Calif.
John C. Schroeter, '28; June 24, 1996; Bethesda, Md.
Angelo Michael Altieri, '29; May 29, 1996; Watertown, Mass.
Andrew Gregory Ogden, '29; October 20, 1995; Alexandria, Va.
Nathan Rosen, '29, SM '30, ScD '32; December 18, 1995; Haifa, Israel
Charles Fayette Taylor, '29; June 22, 1996; Brookline, Mass.
Jean Victor Kresser, '30; July 20, 1995; Oakland, Calif.
Sven Norman Lindhard, '30; December 18, 1995; New Bern, N.C.
Morrell Marean, '30; February 16, 1996; Lake Worth, Fla.
Ralph William Murley, '30; April 25, 1994; North Andover, Mass.
Margaret Vredenburgh Van Vilas, MAR '30; September 13, 1995; Branford, Conn.
Samuel Bensinger, '31; June 1996; Washington, D.C.
Christian Randolph Binner, '31; February 13, 1996; New Canaan, Conn.
Jeremiah Franklin Cook, '31, SM '32; June 20, 1996; Westport, Conn.
Arthur Gibson Fuller, '31; June 15, 1996; Woburn, Mass.
Roger Gerard Simard, '31, PhD '39; May 12, 1996; Swarthmore, Pa.
Frank Herbert Simon, '31, SM '32; July 7, 1991; London, England
Bennett Archambault, '32; July 7, 1996; Chicago, Ill.
Arthur Lawrence MacKusick, '32; May 10, 1996; Merritt Island, Fla.
Donald Glen Fink, '33, SM '42; May 3, 1996; Somers, N.Y.
William Austin Gray, '33, SM '34; March 16, 1996; Charlottesville, Va.
Peter Parker, '33; December 19, 1995; Bedford, Va.
Vozian Lawrence Parsegian, '33; April 2, 1996; Troy, N.Y.
Walter Fredric Sheblessy, MAR '33; September 1995; Cincinnati, Ohio
Robert Fink Way, '33, SM '34; July 1, 1995; Short Hills, N.J.
Arthur Leonard Conn, '34, SM '35; January 5, 1995; Chicago, Ill.
Bicknell Joseph, '34, SM '37; July 22, 1996; Kingman, Ariz.
Henry Regnery, '34; June 18, 1996; Chicago, Ill.
Frederic Schappert, '34; December 21, 1995; Springfield, Va.
Marcy Leavenworth Sperry, '34; November 6, 1995; Walden, N.Y.
Harold Frederick Eldon Dixon, '35; June 10, 1986; Saratoga Springs, N.Y.
Alfred Lincoln Greenlaw, '35; January 2, 1996; Issaquah, Wash.
John Stuart Holley, '35; May 4, 1996; Chula Vista, Calif.
Prescott Arthur Smith, '35; April 19, 1996; Concord, Mass.
Horace Irvin Etchells, SM '36; October 1,

1995; Orlando, Fla.
Jacques Kemner Laflamme, '36; November 12, 1995; Montreal, Canada
Louis Cass Young, '36, SM '37; February 1, 1996; St. Helena Island, S.C.
Puzant William Bakarian, '37; March 27, 1996; Fort Lauderdale, Fla.
Alexander Sus Langsdorf, PhD '37; May 24, 1996; Schaumburg, Ill.
Gurdon Montague Butler, ScD '38; January 4, 1996; Coronado, Calif.
Kenneth E. Fields, SM '38; July 1, 1996; Greenwich, Conn.
Demetrius George Jelatis, '38, ScD '44; June 1, 1996; Red Wing, Minn.
Shih I. Pai, SM '38; May 23, 1996; Beltsville, Md.
Joseph William Steiner, SM '38; September 12, 1994; Naples, Fla.
Thomas James Reading, SM '39; September 21, 1995; Omaha, Nebr.
Albert Charles Waters, '39; December 5, 1995; Boxford, Mass.
Robert Matteson Blunt, '40; August 3, 1995; Denver, Colo.
Abe Markham Gelbart, PhD '40; September 7, 1994; New York, N.Y.
Harrie William Miley, '40; May 5, 1992; Penfield, N.Y.
Winton Lloyd Slade, '40; January 17, 1996; Lancaster, Pa.
Joseph Harriman Myers, '41; October 28, 1995; Irvine, Calif.
Joel Wiesenfeld, SM '41; December 5, 1995; Highland Park, N.J.
Arthur Samuel Spear, '42; December 31, 1995; Upper Saddle River, N.J.
Thomas Francis Connolly, SM '42; May 24, 1996; Holland, Mich.
Moacyr Rodrigues Da Costa, SM '42; March 17, 1996; Ipanema Rio de Janeiro, Brazil
William Hahn, '42; May 12, 1995; La Jolla, Calif.
Edward Orland Jess, '42; March 19, 1995; Richmond, Va.
John Edward Gardner, '43; April 13, 1996; Boynton Beach, Fla.
Robert Edward Harris, SM '45; March 15, 1996; Seattle, Wash.
Emilio Hoigne, '45; May 25, 1996; Sarasota, Fla.
John Everett Plantinga, '45; June 26, 1995; Westport, Conn.
Marion Geraldine Ingram, SM '46; June 12, 1996; New York, N.Y.
Harry Pearce Kling, SM '46, ScD '49; May 27, 1996; Glen Arm, Md.
John Baron Littlefield, '46; July 3, 1996; Riverside, Conn.
Edward Melick Townsend, '47; October 20, 1995; Houston, Tex.
John Bertram Giever, PhD '48; February 24, 1994; Las Cruces, N.M.
Barton Brown, '49, SM '50; August 4, 1995; Austin, Tex.
Ernst Michael Gyorgy, '50, PhD '53; May 20, 1995; Madison, N.J.
Algird Kreuchunas, PhD '50; April 15, 1996; Detroit, Mich.
William Oscar Schach, SM '50; April 13, 1996; Pittsburgh, Pa.
Robert Stone Hudders, '51; May 13, 1996; Buffalo, N.Y.
Joseph Arthur Lovington, SM '51; November 6, 1995; Reedville, Va.
Floyd James Keirnan, '52; April 28, 1996; Citrus Heights, Calif.
Theodore Clay Uhler, '52; October 29, 1995
Hua Lin, ScD '55; October 4, 1995; Mercer Island, Wash.
Richard Arlington Miller, '56; November 23, 1994; Midlothian, Va.
Leonard Philip Skolnick, ScD '58; March 6, 1996; Harwood, Md.
Richard James Crittenden, PhD '60; June 26, 1996; Birmingham, Ala.
Lawrence Scott Partridge, MAR '60; February 24, 1995; Birmingham, Ala.
Lawrence Whitcomb Barss, PhD '61; June 24, 1996; Belmont, Mass.
Emerson Bryant Griswold, '62; January 20, 1996; Janesville, Wis.
Thomas Ludwig Jernick, '65, SM '67; March 10, 1996
Richard Edgar Molari, Jr., '65, SM '66; March 1996; Pittsfield, Mass.
George Stephen Boolos, PhD '66; May 27, 1996; Brookline, Mass.
David Putnam Osborne, '67; March 7, 1996; Silver Spring, Md.
Susumu Mitarai, '67; April 18, 1995; Westfield, N.J.
Michael Allen Lew, SM '69; June 17, 1995; McLean, Va.
David Alan Spear, '71, SM '72; October 22, 1995; Manchester, Conn.
Steven Douglas Larson, '72; October 21, 1995; Yankton, S.D.
Mitch Kaplan, '73; May 13, 1996; Brooklyn, N.Y.
John D. McNeish, '73; July 18, 1995; Contoocook, N.H.
David W. Swindells, '81; March 17, 1996; Abingdon, England
Barnes Walker Woodhall, '85, SM '85; May 27, 1996; San Jose, Calif.
Madhu Valluri, '87; December 14, 1994; Bombay, India
Jonathan Ervin Roorda, '92; June 9, 1996; Princeton, N.J.

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Massachusetts Institute of Technology

REPORT OF THE PRESIDENT

for the Academic Year 1995-96

IN THIS AGE, IN THIS COUNTRY, THERE IS AN OPPORTUNITY FOR THE DEVELOPMENT OF [HUMANKIND'S] INTELLECTUAL, CULTURAL, AND SPIRITUAL POTENTIALITIES THAT HAS NEVER EXISTED BEFORE IN THE HISTORY OF OUR SPECIES. I MEAN NOT SIMPLY AN OPPORTUNITY FOR GREATNESS FOR A FEW, BUT AN OPPORTUNITY FOR GREATNESS FOR THE MANY. ——*Edwin H. Land*

In 1957, nearly 40 years ago, Edwin Land, the founder of Polaroid, gave the Arthur Dehon Little Memorial Lecture at MIT.[1] His address was entitled *Generation of Greatness: The Idea of a University in an Age of Science*. In it, he set forth his conviction that everyone is born with the potential for greatness and that we must be far bolder in our vision and commitment to develop the full creative powers of our young.

His proposal for how universities might meet this challenge was to create within each university small communities of faculty and students who would work together as colleagues in scholarship and research . . . where learning would become, once again, an exciting adventure. This proposal led to the establishment in the 1960s of the Undergraduate Research Opportunities Program at MIT – still one of the strongest features of an MIT education.

But the point here is not that Land had a major influence on education at MIT, but that he had a vision of greatness and a boldness of spirit that were embraced by others. Certainly his influence can be attributed to the power of his intellect and his dream. But perhaps it also had something to do with the times, the dawn of the 1960s, when the country was ready to dream of greatness and to take bold action, and did so in many domains – in science and technology, in education, in civil rights.

IS BOLDNESS A THING OF THE PAST?

Today – in 1996 – we live in an age that seems to reject bold thought and bold action. This is true in America, and it is true in Europe. Why is this? Does boldness come with a price tag we can no longer afford? Does it imply excess or waste or impracticality? Are we too cynical to embrace visionary new ideas? Have we turned from boldness because such vision and action usually call for shared commitment . . . and we only care for what affects us personally and immediately? Is this a natural outcome of our maturation as a nation and as a society? Perhaps all of the above. Or perhaps, at century's end, we have become so concerned with eliminating the budget deficit in order to protect future generations from economic grief that we are blind to the equal importance of making the investments necessary to assure the vitality and quality of their lives.

I do not believe, however, that for most Americans, or for most people around the world for that matter, such limited vision is a conscious choice. We have slipped into complacency and self-interest, but we need not, and cannot, remain there. As a society we must once again believe that we can envision and generate greatness in our time, and build the foundation for future generations of greatness.

SCIENCE AND TECHNOLOGY – GREAT EXPECTATIONS?

I am not alone in this belief or desire. Take science and technology, for example.

A new national survey[2] finds that the vast majority of Americans want this country to be the world leader in scientific and technological progress as we

enter the next century. They believe that public policy and federal investment should encourage education, research, and careers in science and technology – in order to build a better future for the nation as a whole and for the everyday lives of individual citizens.

And yet, we do not seem to have the will to stay on this course.

Superconducting Supercollider

One major scientific project illustrates the point. A decade ago the United States committed itself to constructing the Superconducting Supercollider (SSC), a huge new particle accelerator that would have helped us to answer critical questions in particle physics and perhaps discover another force of nature. The frontier technology required to build this project also could have led to important technological innovations of practical benefit to the general society. We invested over $2 billion and got construction well underway. Then we simply changed our mind, walked away, and left a rusting hulk in the arid Texas desert – too expensive.

But more than just expense was involved. We – the science community and the federal government – knew that this was an expensive undertaking when it was conceived and given the go-ahead. It could have been a truly international project, but it was supported in part in order to do it all ourselves, in a nationalistic spirit. Yes, the Japanese were invited to help fund it, but only after the concepts and designs were completed and construction was underway – hardly a true international undertaking.

Then there was the matter of location. The SSC was vigorously supported by the Congress and by the public in several parts of the country – until it was sited. Not surprisingly, it is more attractive to support an activity in one's state or district than if it is located thousands of miles away. Yet, in reality, facilities like the SSC would be shared by researchers – faculty and graduate students from all around the nation and the world.

My purpose here is not to argue that the SSC should have been built; many good people disagreed about that. My point is to ask why we cannot conceive and carry through such bold ventures – why our commitments have no staying power.

The Magnetic Fusion Program

Other science and technology programs also illustrate the point. Take, for example, our nation's magnetic fusion program. As the trauma of the 1970s' oil embargo and other "wakeup calls" regarding worldwide energy needs have receded in our memories, we have ceased to think much about the future of energy supplies and utilization. The most conservative analyses indicate that we will need at least to double worldwide energy production by 2050 if nations around the world are going to have the opportunity to become industrialized and improve their standards of living. At the same time, doing this in a way that does not degrade the earth's atmosphere to an intolerable extent represents a major challenge. Just consider one country, China, with a population of 1.2 billion people, which is developing its industrial base and meeting its heating needs primarily by burning coal. Meeting the demand for energy throughout the world will require new technologies for large-scale generation of heat and electricity that are relatively environmentally benign and that utilize readily available fuels. It is difficult, if not impossible, to construct a scenario that does not involve substantial use of thermonuclear fusion reactors for this purpose. They offer the potential of using essentially inexhaustible fuel, producing very little radioactivity, and releasing no carbon dioxide into the atmosphere.

The problem is that fusion science and technology are very complex and the state of the art must be advanced considerably over the next few decades. A great deal has been learned, but much remains to be done. In 1995, the US magnetic fusion program was funded at a level of $375 million and scheduled to increase substantially in the years ahead, in large part to meet our obligations to the International Thermonuclear Experimental Reactor (ITER) project. ITER is a large joint undertaking of the United States, Europe, Russia, and Japan. In 1996, however, funding for the US magnetic fusion program has been cut to $244 million – and is headed toward a still lower level in 1997. In order to maintain a viable program in the most essential basic fusion science and technology, the US likely will need to drop its commitment to ITER. Reducing our overall fusion program to such levels decreases the probability that our companies will be major players in the provision of power generation plants in the expanding world markets as we approach the middle of the next century. Furthermore, we greatly increase the risk that no acceptable means of meeting world energy needs will be available.

Now let us turn to two bold ventures that, in fact, appear to be moving toward realization: The Space Station and the Human Genome Project.

The Space Station

The Space Station is primarily a technology, rather than a science, project. To a far greater extent, however, it is about humans in space. I believe that reaching beyond the boundaries of earth has an intrinsic value – it is as surely a part of the ongoing human adventure as Hillary and Norgay's ascent of Mount Everest, the Lewis and Clark expedition, the sixteenth-century explorations of Vasco da Gama, or the

fifth-century Polynesian expeditions across 2,300 miles of open ocean to Hawaii.

Some of the most wondrous and important explorations of space have been made remotely, by spacecraft with no crews aboard: the Hubble Telescope's observations of the Shoemaker-Levy Comet collision with the planet Jupiter, or the Galileo Space Probe's magnificent exploration of Europa, Ganymede, and other Jovian moons. Remote exploration through technology should continue to expand our understanding and sense of wonder about the universe.

Still, the human presence in space captures the imagination of most people. The realization that in the entire sweep of human history, my generation was the first to go beyond the bounds of the earth is both a marvel and an inspiration. Children, in particular, remain entranced by this adventure – always a sure sign that something is worthwhile.

Now, fundamentally, the Space Station can do only two things that cannot be done in other ways. It can put humans into a microgravity environment for very long periods of time, and it can put very massive objects into orbit for very long periods of time. Why should we want to do this? For one thing, we will be able to perform empirical medical studies that are necessary preludes to future interplanetary flights.

And while the Space Station is basically a technology project, the ability to place massive objects in orbit for sustained periods of time appears to be leading to an important, though initially unintended, role for the Station in fundamental science. The Alpha Magnetic Spectrometer, conceived by MIT/CERN physicist Samuel Ting, will be placed on the Station. There the device, which will weigh two tons and be about a meter high and a meter in diameter, will allow us to study the properties and origin of cosmic particles and nuclei, including antimatter and dark matter. Discovering the presence of either material will increase our understanding of the early universe and could potentially lead to a clearer understanding of the actual origin of the universe and to the discovery of antimatter stars and galaxies.

Just as we cannot saddle the coming generations with our financial debt, neither can we saddle them with our societal debt through lack of investment in the future.

The Space Station, whose history and congressional support is checkered, to say the least, appears to be moving toward reality for two reasons. First, it is an international project that overtly became a tool of US foreign policy. Second, there is broad public enthusiasm for human space travel.

The Human Genome Project

The Human Genome Project is the one bold, high-profile, large-scale science project that appears to be moving at a direct, determined pace toward its intended goal. The idea is to tap our newly discovered knowledge of the structure of genes and chromosomes in order to improve our understanding of the physical structure of human life, and, ultimately, to make possible dramatic advances in medical science and health care. Originally, it was thought that a map of the entire human genome could be completed by 1998. In fact, this program has been so successful that the mapping was completed in 1996, and work has now begun on the vastly larger task of sequencing the human genome.

The pace of success has been so rapid because project leaders such as Eric Lander and his team at MIT/Whitehead Institute recognized early on that this was not a task for thousands of biologists and technicians working ploddingly with micropipettes. Rather, it was a problem to be solved through the creative and careful application of combinatorial mathematics, computer science, and robotic automation. Technological innovation, combined with human imagination, made the difference.

In addition, this project has been able to proceed on course because Congress and the public understand that the medical advances so important to all of us spring from such basic biomedical research. They are willing to support the necessary investment in this area because they share the vision and can understand the potential for dramatic returns – in the form of better health and improved quality of life.

It is much more difficult, however, to generate such shared vision for basic research that does not hold such immediately recognizable benefits. We have a quandary. Most Americans, when asked, say that they expect science and technology to solve some or most of the problems faced by our society, and that in order for that to happen, we should invest in research and put more emphasis

on science in our schools. But at the moment, at least as far as the long-term prospects for research funding go, we seem to be moving in the opposite direction.

Somehow, as a nation we are unable or unwilling to make the sustained investment or have the confidence that will ensure the kind of future we want – a future made brighter by cures for cancer and mental illness; by clean, renewable energy; by sustainable industrial development; by broadly accessible transportation and information systems; by affordable food and shelter; and by expanded horizons.

There is legitimate concern about how much we can afford to do. We need to balance the national budget so that future generations will not be burdened with our debt. Fair enough. But we need to distinguish between spending for the moment and investing in the future. Just as we cannot saddle the coming generations with our financial debt, neither can we saddle them with our societal debt through lack of concern for the future. We must invest in that future—through education, through research, and through attaining common purpose.

To be effective, this nation must match boldness with staying power.

Education – Pass, Fail, or Excel?

The American educational system certainly developed through a series of bold assertions and actions. It is an essential part of our national heritage. What assertion could have been more bold in the eighteenth and nineteenth centuries than the belief that for a democracy to function and a nation to thrive, education must be the universal right of our young? What action could have been more bold than the passage of the Morrill Act, providing a large grant of land to each state to enable the establishment of universities that would provide higher education to vast numbers of young men and women, mostly of modest means? And, in our own century, what step could have been more dramatic, or have better provided for our future, than the establishment of the GI Bill? This is the stuff of greatness, nation building, and empowerment.

Today, however, we have evolved into a truly paradoxical situation. We have, by a huge margin, the greatest and most effective system of higher education in the world – in terms of quality, accessibility, and creation of new knowledge. At the same time, we have a system of primary and secondary education that is a national shame, one that is a surefire determinant of national decline if it is not corrected.

Repeatedly we have set national goals to be met by our schools by the year 2000 – just four years hence: goals that call for our students to be first in the world in science and mathematics achievement, and for every school to be free of drugs and violence. But few seem serious about accomplishing such goals. Too ambitious.

Our schools, especially in large cities, have had thrust upon them social ills with which they are not prepared to deal – parental indifference, students with low expectations, outmoded and decaying infrastructure, political infighting, misplaced ideology, meaningless bureaucracies, and insufficient financial support. But these are symptoms. They are symptoms of a loss of national will and vision, uncertain or nonexistent values, and lack of respect for our most important profession – the profession of teaching our children.

I do not profess to know the answer to improving America's public schools, but it must begin with a bold reassertion that nothing is more important than preparing our young to face the future.

To do that, I suggest that we must give our students the ability to live, act, and contribute meaningfully in a world that is ever changing. This will require far more than simple mastery over a body of knowledge. We need to prepare our students with a solid foundation in the sciences, social sciences and the humanities to appreciate what they encounter, and we need to do so in ways that will provide them with the skills to negotiate the unknown. To be prepared for the future, our students must be intellectually adventurous.

This is not the place to lay out a set of educational goals for our schools, but I would suggest that there is much to be learned from a set of national standards for science education recently developed by the National Research Council.[3] These standards are based on principles that could apply to many fields. They are based on studying the changing needs of our populace, the changing nature of science itself, and successful educational practices. The standards promote science as discovery, rather than science as a collection of facts to be memorized and accepted. Students are encouraged to develop skills of analysis and synthesis and perspective. Our educators should explore these standards as well as the associated pedagogical techniques. If they were to be adopted, we would see some fundamental changes in

the way we assess the progress and preparation of our students. There is much to be learned that could inspire a whole new generation of students and teachers.

Setting ambitious educational goals is one thing. But we will not attain them unless there is broad societal recognition of the importance of the teaching profession. We must support our committed teachers, and we must create a new generation of teachers who are well educated, future-oriented, technologically literate, willing to be accountable, and excited to explore new ways of teaching and learning.

This is only the necessary condition, however; it is far from sufficient. These teachers must be supported by our citizenry of all ages, by government at all levels, by the mass media and the entertainment industry, by sports figures, by the criminal justice system, and, above all, by the parents and guardians of the young. They must be provided with the tools, the resources, the financial rewards, and the respect to do the job that must be done.

There is progress on at least one of these fronts. There appears to be enthusiasm and action at both federal and state levels, and within the private sector, for connecting all of our schools to the Internet by the end of the decade. This is a bold move, and it is appropriate. But the technical and financial requirements and capabilities must be thought through with great care, though expeditiously. Then the real question must be addressed: How can this new technology enhance learning?

First, of course, teachers must have the necessary understanding of and access to computers and information systems. But beyond that, the community of educators must become a learning and sharing organization. Herein lies the promise: There must be ways of sharing and learning from each other's experiences. The theory and practice of *learning organizations* must be tapped for techniques applicable to our educational system in the large.

The use of the World Wide Web and related tools holds huge promise for sharing learning resources. In the hands of skilled educators networked across the country, one school can produce a small, effective video, text, or other segment on, say, basic cell biology. Another school can produce brief segments about elementary algebra, another can address instruction in Spanish, and yet another may develop an exciting history unit. Individual teachers can then pull different units together to form coherent learning tools for the use of each class or student. By making all of these units available through the World Wide Web, it will be possible to share expertise, and achieve savings, on an unprecedented scale. There is no reason that this kind of collaboration need be restricted to the United States. The opportunities to share and work in education across national boundaries should be seriously explored; they will serve future generations well.

ARE WE STILL A LAND OF OPPORTUNITY?

When we think of the future, scientific and technological innovations often come to mind. But the quality of our future will have even more to do with human relations than it does with science and technology. If this nation is to thrive – economically, socially, politically – we must do all we can to ensure that all of our citizens are able to reach their full potential. Only then will we realize the full benefits to be found in a society peopled with different cultures, races, and nationalities.

Race and Society – One Nation or Many?

In the 1950s and 1960s, we as a nation determined that we would build a racially integrated, nondiscriminatory society, and we recognized that various interim commitments and corrective actions would be required until we reached that goal. Full attainment of that goal has proved more elusive than most anticipated. We now seem to be backing off in many ways – too ideological; too uncomfortable; too difficult.

Educational institutions have had central roles in both the action and debate throughout this period. Fundamentally, this is because of our special responsibility to prepare young people to take their full place in our society. Indeed, America's course in these matters was largely set by the 1954 Supreme Court decision in *Brown* v. *Board of Education* that laid the foundation for the affirmative action initiatives of the 1960s by ordering racial integration of public schools with all deliberate speed.

Today, more than 40 years after *Brown* v. *Board of Education*, we still find ourselves at the center of discussion, evaluation, and legal decisions about race and diversity. Largely because of explicit actions to increase access to our colleges and universities, most have become much more diverse racially, culturally, and economically. The presence and role of women on our campuses have improved dramatically. Still, most campuses cannot be judged to be broadly representative of the makeup of contemporary America. Statistics regarding most measures of academic success and access of young people to career, professional, and leadership tracks tell us that the goals set in the 1950s and 1960s have not yet been achieved. My sense is that we are losing will, ignoring realities, falling into political partisanship, and, not infrequently,

introducing mean-spiritedness into the national debate on these matters.

Effectively addressing issues of race and diversity is too essential to the future of the United States to allow it to be dissipated in partisan rhetoric. Maintaining our momentum is too urgent to allow it to be defined away through narrow, technical judicial decisions. Reinvigorating a national commitment is too demanding to allow it to drown in a sea of red tape. We need both idealism and pragmatism, but we cannot, through what Father Theodore Hesburgh refers to as "combat fatigue," enter the next century without making real progress toward broad equality.

It astounds me how frequently the issue of diversity is addressed as if it were an abstract concept. Racial diversity is a *reality* of American life in 1996, and we know with certainty that it will be an even more dominant reality in, say, 2015, when the children being born this year are of college age. In 2015, the college-age population of the US will be 16-percent African-American and 19-percent Hispanic-American, and the mix of new immigrants to our shores, especially from Asia and Southeast Asia, also will contribute more substantially to the makeup of our citizenry.

By the year 2015, the work force will be one-third white male, one-third white female, and one-third people of color. All these workers will be toiling to support not only themselves, but all of us who, as retirees, will be dependent upon them – and they will constitute a much smaller proportion of our population. (In 2015, there will be only half as many people working and supporting the retired population as there were in 1960.) If they do not form a cohesive, productive society, the future will indeed be bleak. This prognostication is truly daunting, especially when combined with the fact that we will need to compete in a marketplace and economy that will be even more globalized and integrated than today.

Thus, even if we are willing to ignore the historical imperative and noble goal of equality and true integration, we must be problem solvers and set a sound course for our rapidly changing nation.

It is sorely tempting to declare victory and turn our back on affirmative action and related processes in America. How pleased I would be if we could legitimately assume that all of our citizens have reached a sufficient state of actual equality of opportunity and access that we could adopt simple, race-blind approaches to all that we do. That, of course, is the goal. But is it an honest evaluation of the situation today? One need only peruse the extensive tabulations of national statistics regarding wages, crime, education, health, and many other parameters in Andrew Hacker's book, *Two Nations: Black and White, Separate, Hostile, Unequal* to know that we have not achieved anything approaching equality across the racial boundaries of our society. If that is not convincing, read the front page of any urban newspaper on any given day.

Yet we are retreating. The federal district court ruling in *Hopwood* v. *University of Texas* has already had repercussions around the country – as organized efforts to end affirmative action continue to grow. The actions of the University of California's Board of Regents are well known; and in Colorado, the governing board of the university system has cut back on affirmative action programs. Other efforts include legislative moves in Pennsylvania and Arizona to outlaw affirmative action, and more than a dozen campaigns to amend the constitutions of various states.

In this context, I use the term "affirmative action" rather broadly to refer to programs or actions that specifically foster access or participation of minority groups or women in educational programs or jobs. This breadth seems appropriate in discussing universities in light of recent court decisions. MIT's admissions process is consistent with the Supreme Court's 1978 *Bakke* decision that universities may consider race "as one factor among many" in making admissions decisions. We build our admitted class to bring together students from diverse geographic, economic, cultural, racial, and experiential backgrounds, all of whom have exhibited the intellectual capacity, achievement, and motivation that are needed to succeed and benefit from MIT. Furthermore, our undergraduate financial aid is awarded solely on the basis of demonstrated financial need.

Yet in 1996, in *Hopwood* v. *University of Texas*, the Fifth Circuit Court of Appeals effectively reversed the *Bakke* decision for public institutions in Texas, Mississippi, and Louisiana, by declaring that "*any* consideration of race or ethnicity by the law school for the purpose of achieving a diverse student body is not a compelling interest" and therefore is not permitted.

I do not wish to defend across the board all federal affirmative action laws and set-aside policies, with their attendant red tape, cumbersome bureaucracies, and often artificial metrics. But I do want to defend the core concept that determined, often race-specific consideration and effort are still essential to move us toward the integrated, cohesive society we will need in the years ahead. The society I believe we will need is one in which individuals can realize their potential, and in which we can draw effectively on the individual and collective strengths and talents of our citizens of all colors and ethnicities. We cannot command, decree, or wish into existence such a nation. Rather we must work proactively to build it through the environments and opportunities we create

for learning and working.

The idea that affirmative action programs are unnecessary or even unconstitutional is gaining momentum just at a time when we in science, engineering, and higher education are beginning to see some real results from these programs.

Last summer, the American Council on Education released its study on minorities in higher education,[4] and reported a record number of Ph.D.'s awarded to black graduate students in 1995. And over the past eight years, the National Science Foundation reports,[5] there has been a 75-percent increase in the number of science and engineering doctorates awarded to black graduate students – from 319 in 1987 to 557 in 1995. The media and others have hailed this as a dramatic increase. It is, indeed, real progress; nonetheless, the absolute numbers are stunningly small. Last year, for example, the number of blacks receiving the doctorate in electrical engineering in the US rose 40 percent over the previous year – to 24. Yet this is out of a total of 966 doctorates awarded in that field.

And yet there are arguments over the reasons for this progress. Supporters of affirmative action claim the increase as evidence of the programs' effectiveness, while critics argue that it is the result of increased educational opportunities, and that any benefits of affirmative action are offset by the negative effects of what they regard as preferential treatment of minorities.

Did "affirmative action" play a role in this modest success? It should not be a difficult matter to assess how many of these new Ph.D. graduates were definitively encouraged or enabled to reach this high level of attainment by specific programs or support. It should not be a matter of guesswork; the data should be obtained and affirmative action and outreach programs should be objectively evaluated on the basis of outcomes over time. It should not be a matter of ideology of the left or of the right. We should assess where we are, demonstrate what does and doesn't work, and get on with the job.

Racial and ethnic diversity is not an abstract concept; it is the reality of American life in 1996, and it will be an even more dominant reality in the next century.

In the current legal environment, attorneys are recommending to organizations that were established specifically to promote educational opportunity for minority students that they modify their eligibility criteria to indicate that they will review applications without regard to the applicant's ethnicity. Frankly, this strikes me as a strange and artificial approach.

My own view is that we must hold to our principles if our nation is to benefit from the full range of talent needed to meet the challenges of a changing world. Our journey is not over. Our goal is not attained.

I believe that the time will come when affirmative action programs will no longer be necessary, but for now, we still have a compelling need for proactive efforts, despite calls by some that what is needed instead is simply stronger enforcement of antidiscrimination laws. Indeed, as Tom Wicker put it in his recent book, *Tragic Failure:* "If enforcement of antidiscrimination laws is the alternative to affirmative action, race, sex, and ethnic discrimination will be with us for a long time."

An Open Society – To Whom?

Race is not the only focus of the argument about how open our society should be. These are economically difficult times in America – at least relative to our aspirations and to the post-war boom years. And as times get tight, there is a natural tendency to turn inward. So once again, we hear concerns that we should not be educating so many foreign graduate students. We hear that immigrants are a major cause of our woes. And we keep pulling apart into homogeneous groupings of one sort or another. But just because these are natural or understandable tendencies does not make them right.

America has always been a nation of immigrants and we have always been a land of opportunity. These statements perhaps sound quaint or old fashioned, but they are true, and we must retain their spirit.

Each year, my wife Becky and I host a dinner in our home for the men and women who are retiring from the tenured faculty ranks of MIT. These are always extraordinary assemblages of talented and accomplished colleagues – people who have defined MIT, and who have defined their professional and scholarly fields. No lack of bold thought there!

Yet, as I survey that room each spring, I realize how much MIT and indeed America have benefited from our being open to those from other countries, and

how wise has been our tradition of selecting and advancing people on the basis of their talent and accomplishment rather than their wealth or nationality. Now, some might say that this represents a passing era, that what I am observing has its origins in the intellectual migrations from Europe associated with the turmoil of the World War II era. Or it might even represent the vestiges of the times during which the leading universities in science and engineering were in Germany and England.

No, it is an ongoing fact that the excellence of our institutions is due in very large measure to our openness to international scholars. MIT faculty who have received the Nobel Prize include individuals who were born in Japan, India, Italy, and Mexico. Our provost was born in Israel. We have deans who were born in Canada and Australia. Almost all came to the US as graduate students.

In fact, about one-third of all Ph.D. degrees in science and engineering earned in US universities are awarded to foreign citizens. (In engineering alone, half of the Ph.D.'s are earned by foreign citizens.) Many of these doctoral recipients initially pursue their careers in the US, and about 40 percent of them appear to remain here permanently. What a magnificent resource for our industries, universities, and government laboratories. Openness and meritocracy are what have made our universities great, and we must continue that spirit and philosophy in our national endeavors.

At the same time, we should concentrate on improving both science education and general education in this country's K-12 system in order to increase the number of motivated, well-prepared students entering universities and colleges. We should value more highly intellectual pursuits and celebrate the accomplishments of those who contribute to our health and quality of life by advancing science and technology. This is the way to ensure that, in the long run, our graduate programs have a larger, more stable base of US students.

We must, however, continue to provide access, opportunity, and welcome to the brilliant immigrants who contribute so much to our society – people like Institute Professor Hermann Haus, who received the National Medal of Science this year. Recollecting the call from John Gibbons, the President's Science Advisor, Professor Haus said, "I did not trust my senses, at first. After the news sunk in, the thoughts that came to my mind were that I was grateful to my fate for having come to the US, a victim of the 1945 ethnic cleansing in Yugoslavia; for becoming a citizen; and for the recognition I received on account of work I thoroughly enjoyed and for the privilege of association with outstanding students and colleagues."

I can think of no more eloquent description of what it means for this country to be the land of opportunity. We must retain our commitment to this bold dream.

END NOTE

Boldness and openness are qualities that we as a nation must seek to preserve and advance. We in America's research universities have a particular duty to do so.

Boldness flows from a spirit of adventure and a "can do" attitude long associated with America. These characteristics must again be dominant. To be effective, however, we must remember that boldness must be accompanied by staying power. Staying power is waning. We increasingly are better at starting things than at carrying them through. Contemporary politics demands "change" and new vision at least every two to four years. Our budget cycles cause us to be unreliable international partners as we start and stop projects. Staying power does not mean stagnation, it permits the fulfillment of bold ideas, with plenty of correction, evolution, and adaptation along the way.

Openness flows from a spirit of generosity that has long characterized America, but which today appears to be in peril under the stresses of change, slow economic growth, and increasing uncertainty of the future. We must not allow this to happen, for openness and generosity can only be replaced by narrow expectations and selfishness.

We must, instead, choose to be bold and to be generous of spirit. We must believe in the possibility of greatness, for our society today and for the generations to come.



Charles M. Vest

CHARLES M. VEST
September 1996

1 Edwin H. Land, *Generation of Greatness: The Idea of University in an Age of Science,* Ninth Annual Arthur Dehon Little Memorial Lecture, delivered at the Massachusetts Institute of Technology, Cambridge, Massachusetts, May 22, 1957.

2 National survey on public opinion of science and technology, commissioned by the National Science and Technology Medals Foundation, and conducted in June 1996 by the Roper Center for Public Opinion Research at the University of Connecticut.

3 *National Science Education Standards,* National Academy Press, 1996.

4 Reginald Wilson and Deborah Carter, Minorities *in Higher Education 1995-96: 14th Annual Status Report,* American Council on Education, June 1996.

5 *Selected Data on Science and Engineering Doctorate Awards, 1995,* Division of Science Resource Studies, Directorate for Social, Behavioral and Economic Sciences, National Science Foundation (NSF 96-303).

Readers can find this report (and register their comments) on the Web: <http://web.mit.edu/president/communications/rpt95-96.html>.

PuzzleCorner

Editor's Note: In the October issue, we accidentally published a repeat of the first page of the A/S Puzzle Corner, along with the second half of the solutions for M/J. The real puzzle was how to rectify this with the least disruption. Therefore: the Oct. problems now become N/D; here also are the first half of the M/J solutions and all of the July solutions. In the February/March '97 issue, there will be no October solutions, but all will then be back on track.

Since this is the first issue of a new academic year, I once more review the ground rules under which this department is conducted.

In each issue I present three regular problems (the first of which is chess, bridge, go, or computer-related) and one "speed" problem. Readers are invited to submit solutions to the regular problems, and three issues later, one submitted solution is printed for each problem; I also list other readers who responded. For example, solutions to the problems you see below will appear in the February/March issue and the current issue contains solutions to the problems posed in May/June. Since I must submit the February/March column in November, you should send your solutions to me during the next few weeks. Late solutions, as well as comments on published solutions, are acknowledged in subsequent issues in the "Other Respondents" section. Major corrections or additions to published solutions are sometimes printed in the "Better Late Than Never" section, as are solutions to previously unsolved problems.

For speed problems the procedure is quite different. Often whimsical, these problems should not be taken too seriously. If the proposer submits a solution with the problem, that solution appears at the end of the same column in which the problem is published. For example, the solution to this issue's speed problem is given below. Only rarely are comments on speed problems published.



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO: ALLAN GOTTLIEB
NEW YORK UNIVERSITY
715 BROADWAY, 10TH FLOOR
NEW YORK, N.Y. 10012,
OR TO: GOTTLIEB@NYU.EDU

There is also an annual problem, published in the January issue of each year; and sometimes I go back into history to republish problems that remained unsolved after their first appearance.

Problems

N/D 1. We begin with a bridge problem from Dudley Church, who wants to know if South can make six spades against an opening lead of the heart king?

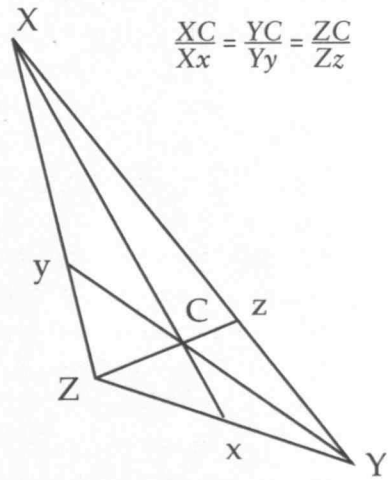
North
♠ K Q 3
♥ Void
♦ J 6 5
♣ A K 10 8 5 4 2

West	East
♠ J 8 4	♠ 2
♥ A K 6 3	♥ 10 9 8 7 4 2
♦ K 10 9 3	♦ 7 4 2
♣ 9 6	♣ Q J 7

South
♠ A 10 9 7 6 5
♥ Q J 5
♦ A Q 8
♣ 3

N/D 2. In the diagram below C is a point inside an arbitrary triangle XYZ. Nicholas Strauss has drawn a line segment from X through C and ending on the opposite side at a point we call x. Similarly, he has drawn lines starting at Y and Z and ending at y and z. Show that

$$\frac{XC}{Xx} = \frac{YC}{Yy} = \frac{ZC}{Zz}$$



N/D 3. Joseph and Charles Horton have inscribed a hexagon with side lengths 2,2,2,11,11,11 in a circle of radius r. What is the value of r?

Speed Department

Ken Rosato and his calculator have found a function f such that for x={0,1, 2,3,4,5,6,7,8,9}, f(x)={6,1,3,2,0,0,0,4, 1,3}. What is this function?

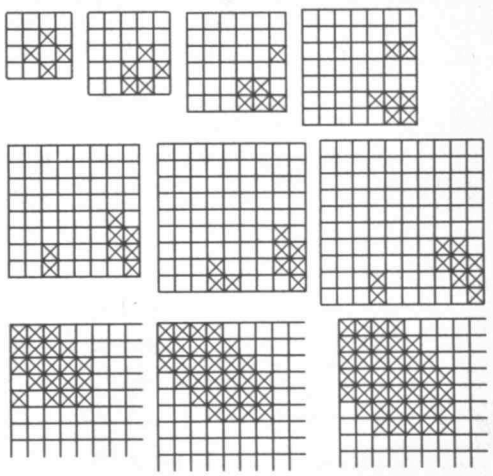
Solution for M/J 1

M/J 1. Mario Velucci wants you to place N queens on an N by N chess board so that the maximum number of vacant squares are Unattacked. For N=1, there are no vacant squares, and, for N=2 and N=3, all vacant squares are attacked. But, for N=4, you can leave 1 vacant square un-attacked and, for N=5, you can leave 3. How about N=10 and N=20 or possibly even N=30?

Robert Bart notes that by bunching the queens in a corner, two triangular regions near the opposite corner are free, i.e. un-attacked. As N gets large, so does Free(N), the number of free squares. Your editor wonders if one can show that Free(N) grows at least linearly with N, i.e., Free(N) = Ω(N).

The diagrams and explanations below are from Matthew Fountain. The proposer supplies values for Free(N) for all N up to 30. His only disagreement with Fountain is Free(N)=22, but no diagram was supplied.

The 10 diagrams show the position of the N



queens that allows the following number of free squares: 1 when N=4, 2 when N=5, 4 when N=6, 7 when N=7, 11 when N=8, 15 when N=9, 21 when N=10, 145 when N=20, 420 when N=30, and 841 when N=40. In cases of N<7 I

Continued on Page MIT 36

MIT LIFE INCOME FUNDS

MR. AND MRS. QUENTIN D. GROVES

HOME: Berkeley Heights, New Jersey

CAREER: Quentin Groves entered MIT with the Class of 1941. Because he left to earn money and serve in the US Army, he graduated in 1947 with a degree in electrical engineering. After working in AT&T's long-distance service, he joined Bell Laboratory in 1957 as a systems engineer in telecommunications, determining systems requirements and applications for the products that were coming out of development. He retired in 1984.

Long interested in education, Quentin volunteered for the PTA while his children were in school. He then became a member of the Berkeley Heights School Board, serving as president in 1969-70. Now he works with elementary school students. He has also been an active fundraiser for MIT.

Quentin and Priscilla Groves celebrated their 50th wedding anniversary in 1992 with a trip to Hawaii. They are avid tennis players.

MIT LIFE INCOME FUND: Quentin D. and Priscilla J. Groves Charitable Remainder Unitrust.

QUOTE: The MIT life income fund approach made it possible for us to give more to MIT than would otherwise have been possible. While this will benefit MIT in the future, it has immediate advantages for us with the diversification and professional management that the plan provides. I can think of no better way to say "thanks" to the Institute for the opportunities that my MIT degree provided, while gaining the satisfaction of knowing that I will have an ongoing connection with MIT's future.

For more information about MIT Life Income Funds, write or call D. Hugh Darden or Frank H. McGrory at MIT, Room 4-234, 77 Massachusetts Avenue, Cambridge, Massachusetts 0[illegible]4307; (617) 253-3827.

Photo: Richard Howard

By Steve Mirsky

Turning Weather Wonks Into TV Stars



In their quest to become TV forecasters, meteorology students discover public-communication skills essential to growing numbers of scientists.

Chemists often talk about energy levels, quark hunters about charm, relativity theorists about timing. Add grooming to energy level, charm, and timing, however, and you have entered a strange new world for a scientist. In fact the arena is show biz, and the scientist is the weather forecaster, a mainstay of the news since the early days of television.

Weather as science is suddenly the stuff of popular culture, with *Twister* having crammed viewers into movie theaters this past spring and summer. Even in that film, the lead character must face the castigation of his colleagues when he leaves the true religion of research meteorology to take a job as—oh the shame—a TV weatherman.

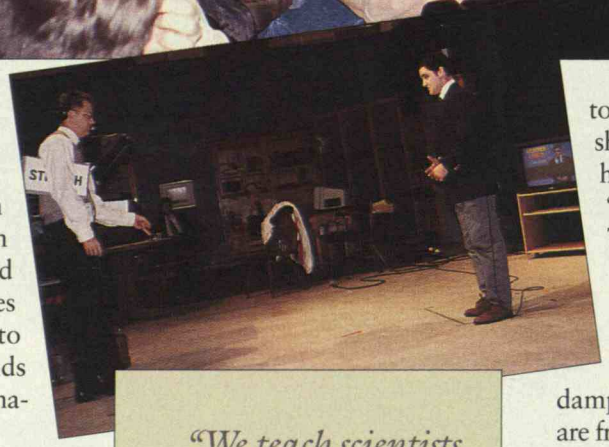
It's true that in the early days of television the weather guys tended to be the court jesters of the newscast, while the weather gals seemed to be local beauty-contest winners. Most of today's 600 or so on-air television weatherpeople, however, are serious about their work. About half are degreed meteorologists.

PHOTOS BY STEVE MIRSKY

That makes them perhaps the best source of technological information and scientific culture that the average person commonly encounters on TV.

The half of television-land's weatherfolks who are not educated in the science disturbs Fred Gadomski, an instructor in the department of meteorology at Pennsylvania State University. "There are a few times each year when the weather gets really serious and it can mean something to your life or your property," Gadomski notes. "At those times, the ability to interpret information of a meteorological nature can mean the difference between life and death. And in those cases, it strikes me as almost irresponsible not to have someone who understands meteorology delivering that information to the public."





For the past 12 years, Gadomski has tried to raise the percentage of scientists among TV weatherpeople by teaching a unique course, Meteo 497b, at Penn State. The course might as well be called TV 101: it trains senior meteorology majors how to be television performers. "Penn State's meteorology department has a long and distinguished academic tradition," Gadomski says. "Yet it recognizes that the way its students may end up applying their knowledge is through communication." When this course began, he notes, "we knew there was a need to train people to understand more than 'the curly Ds'—the differential equations we use to describe the atmosphere."

Students' other classes include physics, chemistry, and math, plus atmospheric dynamics, atmospheric chemistry, physical meteorology, and weather forecasting. But in Meteo 497b, says Gadomski, "we teach scientists how to do *shtick*. Because even if you have the correct information but are unable to communicate it well, you're a lost cause."

"We teach scientists how to do shtick. *If you have the correct information but are unable to communicate it well, you're a lost cause."*

Gadomski trained himself early to communicate. Growing up in Lowell, Mass., he did TV-style weather reports for a very small audience: his family. "My parents were very patient," he recalls. "In the evenings, after watching all the weather forecasts on the evening news, I would prepare my own little map and then I would explain the weather to the family."

Now he explains how to explain the weather to Penn State meteorology majors, roughly half of whom choose to take Meteo 497b. The group meets Tuesday mornings. Attendees dress like typical college students: torn jeans, torn sweaters, day-old T-shirts. Under those college uniforms, however, beat the hearts of the "weather-involved." On one rainy Tuesday, one student rushes into the room holding a few sheets of paper. "It's wet out," he announces excitedly, though they already know. One of the early arrivals grabs the damp papers. "Ooooh," he says. They are freshly printed weather maps.

Gadomski arrives, his glasses still carrying some precipitation. "Welcome on this dark and gloomy day," he says with a broad grin; for weather lovers, the worse the better. Gadomski spends the hour training the students to use computer technology to create, from raw data, jazzy TV graphics that show jet streams and pressure-system maps of lumbering high fronts and low fronts. "Knowledge of graphic systems can be a hiring point," he reminds those soon to be knocking on news directors' doors.

The class also goes over its homework, which was to write a 30-second "Did You Know?" explanation of some weather-related phenomenon that a local forecaster might use. Today's assignment: "Why is the sky blue?"

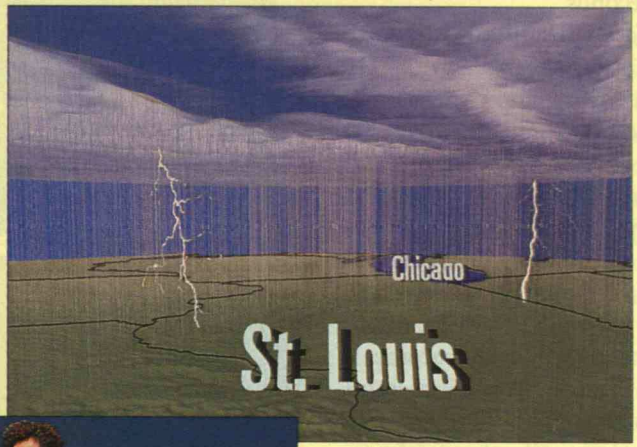
The first student to attempt to explain the sky's cerulean cast uses "polarization" and "light-wave amplitude" in his supposedly viewer-friendly explanation. Gadomski rubs his temples. Viewers "hear the word amplitude," he chides, "and they switch the channel."

The episode highlights the kind of problem a scientist faces when commu-

STEVE MIRSKY, a freelance writer who contributes regularly to Scientific American *and other magazines, always keeps an umbrella handy.*

Getting Them into the Tent

AT 15, Paul Douglas was doing CB weather forecasts for truckers passing near his home in Lancaster, Pa. Later, he became a pioneer in the use of computer graphics in his work as a television meteorologist. The displays were simple, with just a few colors and thick, blocky lines used for arrows and the like, "but at the time people were mesmerized," says Douglas, now meteorologist at WBBM-TV in Chicago. His affection for graphical displays finally led him to create Earthwatch, a system for depicting weather patterns in three dimensions that is now used on more than 60 local stations.





A graphical-display system produces maps that enable television viewers to feel as though they are flying through large cloud formations. The system can also make forecasters appear as if they are surrounded by the weather.

"I became frustrated that there were no tools for showing people the weather in 3-D," Douglas says. He found a programmer, leased a Silicon Graphics computer, and orchestrated the former's efforts with the latter. The result—featuring weather maps that enable television viewers to feel as though they are flying through large cloud formations or rain banks—has been available commercially since 1991.

"We find that flying in from the south, keeping north straight ahead, is intuitive," says Douglas, "and prevents viewers from developing vertigo." The goal is even longer, smoother flybys that show a full weather system and thus enable viewers to see their own local conditions in a more complete context.

Does a snazzy system such as Earthwatch really help the audience understand the weather, or is it just a gimmick? "There is no question that accuracy" has to be "the foundation," Douglas says. "But you've also got to get them into the tent. We're storytellers, and I think the visuals are very important to the telling of the story."

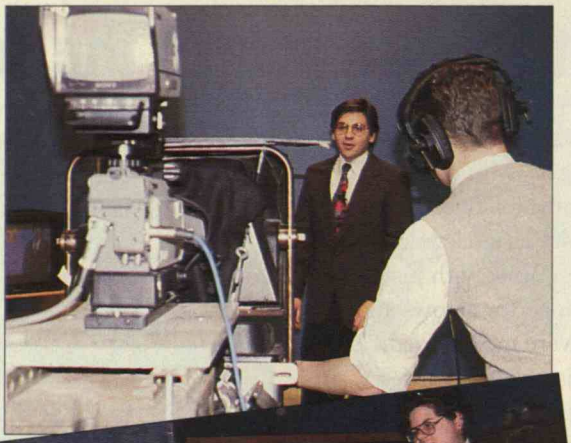
"Yesterday's gimmick has become today's de facto standard," he continues. "When the first computer graphics came out, the purists howled, 'Don't take away my magic markers!'" Originally, TV weather forecasters would stand behind acetate screens with see-through maps and draw arrows and notes like "high pressure" on the surfaces. In those days, the technological achievement was the forecaster's ability to write backward.

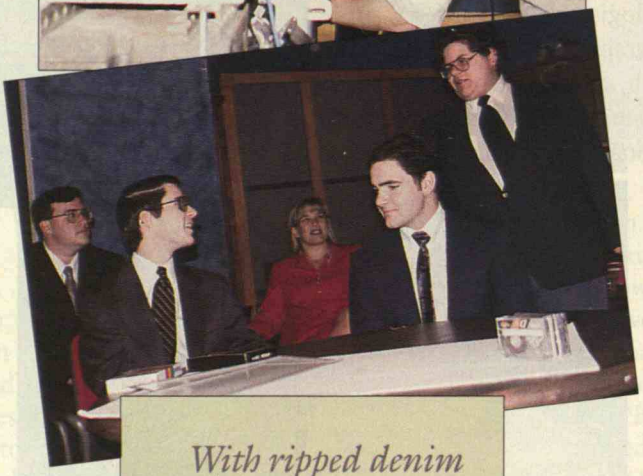
Basically "Earthwatch is like any other tool," says Douglas. "When used effectively, it can tell the story better."—STEVE MIRSKY

nicating with the public—the need to express complex ideas without the shorthand and jargon available when speaking within the tribe. The task of speaking at a level viewers comprehend, but trying not to talk down to them or to dumb down the material, may be the biggest challenge the students face. Donna Pistilli, the lone woman in the group, points out that coming up with a way to describe concepts that the public understands while making the forecast "happy and using inflection is really nerve-wracking sometimes."

Gadomski reminds the students as the class ends that they will be back in the TV studio Thursday facing a challenge. So far they have been practicing the kind of three-and-a-half minute forecasts that typically highlight local television's 6 p.m. and 11 p.m. newscasts, but the class will soon practice the one-minute local forecast familiar to viewers of network morning shows. The students will have to describe what's happening on a regional temperature map and also cram in the forecast for that day, that night,

PHOTOS ABOVE: EARTHWATCH COMMUNICATIONS





With ripped denim transfigured into suits, and breezy attitudes replaced by nervous expectation, students tramp to the TV studio to practice a one-minute local forecast.

and the next day, all in precisely 60 seconds.

"If you spill over, you're going to be stepping on Joan Lunden," Gadomski warns. "And that's going to look real bad to the folks at home." Charles Gudeman, a director from a local TV station who also works with the class, corrects Gadomski: "Actually, the network will just cut you off."

Intensity suddenly becomes a key ingredient to successful communication. "Remember," Gudeman tells the students, "the network is chugging along at a high energy level." (No news to anyone who has wondered what those talking heads are so happy about all the time.) "You have to match that." Otherwise, no matter how compelling the information a forecaster has to convey, he or she will lose the audience.

The instructions simmer for two days. Early Thursday morning, the students tramp through the continuing rain to the studio. The ripped denim has transfigured into suits, with breezy attitudes replaced by nervous expectation. Gadomski rubs his hands together, a mischievous smile on his face. "Who's first?" he asks.

A student named Peter Ernst decides to get it over with. He walks in front of a perfectly featureless, deep blue wall, stopping at a black piece of tape about a yard long on the floor; should he move away from the tape he will disappear from the screen. An exceedingly bored technician raises one hand, then curls down one finger every second, until, with an unexpected flourish, he whips the surviving index finger directly at Peter. At the same moment, a red light goes on atop the TV camera next to the technician. Suddenly, Peter is on live television.

Peter plants a smile on his face. It's phony, but it kicks up his energy level. ("If you can't do anything but smile," Gadomski says, "you're halfway home on TV.") Peter quickly starts through the temperatures and the forecast. As he faces right, he can see an off-camera TV monitor showing him against a map of Pennsylvania and its neighbors. He uses the map on the monitor to find the site he wishes to point at; it looks real enough on television, but in the studio Peter merely waves at air before the blue wall.

Another monitor to his left gives him a similar view should he face in that direction. A third monitor on the camera itself allows him to see his own image and a swirling satellite view of cloud systems when he appears to be making eye contact with the viewer. The maps, the graphics, the satellite views are all fed from the control booth into the TV picture, where they replace the blue background in the camera's field of view. The only complete picture is the one manufactured for television.

Peter continues bolting through his information. He wraps up the forecast, wishing viewers a good day. Then he simply stands there, tiny beads of sweat breaking out on his forehead, his smile melting like the Wicked Witch of the West. Peter has told his whole story in only 45 seconds. Count slowly to 15 and imagine spending all that time in front of the unblinking eye of a television camera with absolutely nothing to say. "Remember not to speak too quickly," Gadomski unnecessarily reminds the class, which has just witnessed the horror. Fortunately for Peter and the rest of the budding weather forecasters, today's broadcast reaches only as far as the control room.

The other students get their chance. Many try to liven up their on-air moment by opening with a comment about the day's dense fog. "It's like pea soup," one student offers in a misguided attempt to be daring. "Looks like a bowl of New England clam chowder," tries another. "Leave a trail of Cheerios to find your way home," quips a third. "Looks like something out of a Sherlock Holmes novel out there," another student tries repeatedly, but keeps saying "Sherlocks." One student's poorly fitting suit collar is shrouded in dandruff. On the monitors the stuff looks like rock salt. He could warn that a tornado is one

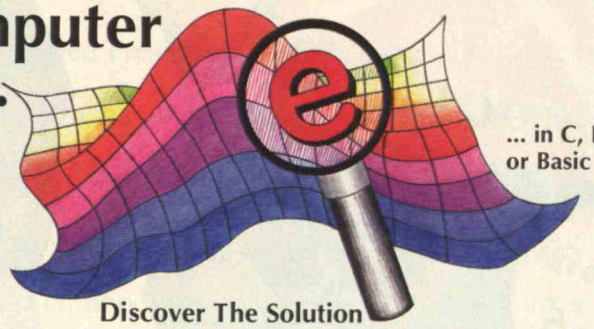
minute away but a viewer would be obsessed with the idea of brushing off his jacket before taking shelter.

After listening to some constructive criticism, everyone takes another turn, and the results are visibly better in the second takes. By the end of the semester, most of the students will have gained at least minimal competency as television performers. Of course, some will opt for a more traditional meteorology job with the National Weather Service, airports, airlines, the military, private weather-consulting firms, or companies that monitor air and water quality. Those people who follow such career paths tend to go beyond "weather-involved"—they are "weather-obsessed."

But those who stick with shtick have a good chance of one day reporting the weather news. "I would rather stay in a local market," says student Walt Schmidt, an Ohio native. "My dream job would be in Cleveland or Toledo," he says. "I don't want to move to New York and do network," on which, he says, forecasters don't actually get to do much meteorology. Pistilli agrees, referring to the weather forecasters that the national morning news shows use along with occasional switches to the forecasters at the local affiliates. "I don't want to be on *Good Morning America*," she says. "I saw Spencer Christian [that show's national-weather forecaster] wearing a big sombrero the other day giving away some trip. That's not what I want to do." She craves a 6 and 11 gig back home in Atlanta. "If you get your jollies at all from the weather," Gadomski explains, the best TV jobs are at the Weather Channel and in mid-sized markets "where there's large audience interest in the weather, plus you get a fair chunk of change to do it."

Graduates of Meteo 497b now get that chunk for air time in Pittsburgh, Savannah, Dayton, Scranton, Albany, and other such cities. Chances are they are the only members of their news teams who have taken more than an introductory course in science. They are the discipline's groundtroops in a medium that goes so far as to feature commercials warning against using unproven psychics when "certified psychics" are available. For a rare few minutes every day, spilling out of that same wacky box that provides endless streams of chatter and visuals about miracle car waxes, prisoners married to their ex-wives' moms, and improbable Red Sox defeats, an honest-to-goodness scientist explains natural phenomena to a mass audience. OK, with glitz. But that's show biz.■

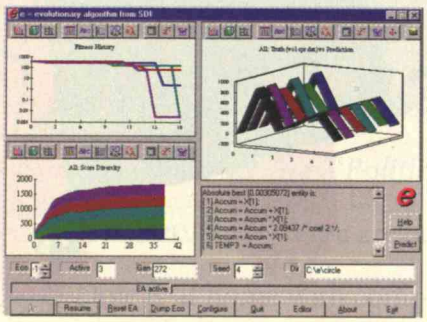
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The Race for Chief Technology Officer

By Edwin Diamond and Gregg Geller

In choosing a president this fall, voters will help guide the country's technological path for the closing years of the millennium.

THE CONTEST between President Bill Clinton and Bob Dole is the first true Information Age campaign. Most of the communications technologies that are considered commonplace today in the campaign were hardly in use when Clinton challenged President George Bush just four years ago.

THE TECHNOLOGY GAP has been closed this year. New media are everywhere evident in the campaign, from Democratic and Republican campaign headquarters with their instant ability to communicate with local party organizations, to the traveling campaign staffs equipped with cellular phones and laptops. C didates and electorate, campaign chiefs and state workers—all are connected, right up to 35,000 feet; both candidates' campaign planes bristle with computers, faxes, and communications equipment to maintain continual contact with the troops on the ground. The candidates also maintain World Wide Web sites to provide information to the Net Set *(see "Politics Online," page 53)*.

THE CANDIDATES THEMSELVES, however, are both low-tech, Gutenberg kinds of guys. Neither Clinton nor Dole is at home with computers or modems. Significantly, neither man has been seen

ILLUSTRATIONS BY VALERIE SPAIN

publicly (or even photographed) using a computer. This is not surprising; the Washington political culture has not been a conspicuously early adopter of technology.

More substantively, science and technology matters have not been accorded an important role in either candidate's campaign. Even scientists considered friendly to the administration acknowledge that Clinton has paid little personal attention to his own President's Committee of Advisors on Science and Technology. The president has "only met with them once in almost four years," according to a senior policy analyst at the Federation of American Scientists. "He's not comfortable with these issues."

One reason that technology has been something of a stealth subject may be that there is in many cases little to argue about. Some large technology-related issues have settled into bipartisan consensus. Nuclear power, for instance, seems to be off the public-policy table, certainly in this century. Republicans and Democrats in the 104th Congress joined to kill funding for one of the only signs of life for future nuclear power—the gas turbine-modular helium reactor. The Department of Energy, through administrations Democratic and Republican, has spent more than $900 million to develop these reactors, which have held a promise of small, relatively inexpensive nuclear power plants that would pose far less risk of catastrophic accident than conventional plants. The project has been allotted a mere $7 million more, for shutdown costs. Clinton gladly signed the bill into law. The candidates agree, too, that schools should make greater use of technology, especially computers and the Internet. And looking skyward, they share a common belief that the United States should push ahead with funding to develop an international space station, in collaboration with Japan, France, Germany, and 10 other countries.

Despite such common ground, Clinton and Dole differ sharply on many other technology issues, principally because of contrasting philosophies about the role of the federal government. Despite his State of the Union proclamation earlier this year that "the era of big government is over," Bill Clinton still believes in an activist—albeit trimmed down—federal presence to set research and education goals, promote the information superhighway, police the environment, and declare its intention to protect a wide range of natural resources, from air and water quality to endangered animal habitats.

Bob Dole, by contrast would eliminate four cabinet-level departments: Education, Energy, Commerce, and Housing and Urban Development. Two of these agencies—Energy and Commerce—now sponsor a large portion of federal R&D. (Dole would transfer the national laboratories to the Department of Defense.) If the Republican victory is decisive enough, President Dole could interpret the vote as a mandate for downsizing government even further, trimming away at R&D funding from across a broad range of federal agencies. If Dole follows through on his pledges to cut taxes 15 percent while increasing defense spending, without significantly cutting Social Security or Medicare, federal funding for science and technology may have to be cut drastically.

The ramifications of this difference affect numerous areas of endeavor. The Democrats, for example, have historically regarded the federal government as an effective promoter of school reform. The Clinton campaign supports Goals 2000, an act promoting national standards in the teaching of core disciplines. Dole argues that public school curriculums should remain the province of state and local authorities and views Goals 2000—a program begun in the Bush administration—as a foolish attempt to micromanage schools. He would replace it with a "G.I. Bill" for the nation's students, which would grant $2.5 billion in federal scholarships to allow parents to choose the schools their children attend—public, private, or religious. Schools, competing for students under a voucher system, would set their own standards, with the educational "market" deciding winners and losers. The hoped-for result is that individual schools will be "free to innovate" with, among other things, ways of using computers and the Internet.

The Environment: How Much Protection?

Clinton and Dole differ most clearly in their attitudes toward the environment—or, more to the point, the environmental-protection role of the federal government. Flush with the GOP's congressional takeover in the midterm elections of 1994, the Dole campaign, as well as House Speaker Newt Gingrich and the Republican House leadership, talked about rolling back regulations for clean air, clean water, and endangered species. Such regulations, according to Dole, have led to "the seizure of private property without compensation." Dole also says he will apply a test of economic feasibility to environmental regulations, asking how every legislative proposal would affect business activities. Indeed, Dole introduced legislation in the Senate to require cost-benefit analysis for any new environmental regulations involving projects larger than $50 million and worked to place limits on the Endangered Species Act.

In this laissez-faire spirit, Dole supports the opening of Alaska's Arctic National Wildlife Refuge to oil drilling. Clinton has denounced this move, claiming he wants "to protect this biologically rich wilderness permanently." Dole and Clinton also disagree about whether to open up for logging Alaska's Tongass National Forest, an ecosystem that is the natural habitat for various forms of threatened wildlife. Dole says yes, Clinton, no.

EDWIN DIAMOND and GREGG GELLER are members of the News Study Group at New York University. They write the weekly column "Medium Cool" for the PoliticsNow Web site, operated by Times Mirror, *the* Washington Post, *and ABC News (www.politicsnow.com). Diamond is coauthor, with Robert A. Silverman, of* White House to Your House: Media and Politics in Virtual America *(MIT Press, 1995).*

Under a Republican administration, environmental policy would become primarily the responsibility of states and local governments. Critics, not all of them Democrats, contend that local regulators would be less able to stand up to, say, big oil and chemical companies. The League of Conservation Voters, which describes itself as a nonprofit watchdog organization, examined Dole's record and gave him a score of zero—in 14 key votes, Dole took the position that the league deemed antienvironmental.

With polls reflecting voters' concerns that the GOP was antienvironment, the Dole campaign has muted its earlier rhetoric exalting individual rights over the protection of natural resources. The retreat reverberated through the compromise of April 25, 1996, which brought an end to the protracted battle of the budget. When the smoke of the debate cleared, the budget agreement, which authorized spending for fiscal 1996, emerged as a decisive victory for the White House. For example, the budget ends Dole's moratorium on new listings under the Endangered Species Act; it also turns back Senate Republicans' efforts to expand logging operations in the Tongass and effectively halts mining plans and other commercial and recreation projects in California's Mojave Desert.



Clinton and Dole's differences on many technology issues flow from their contrasting philosophies about how active the federal government should be.

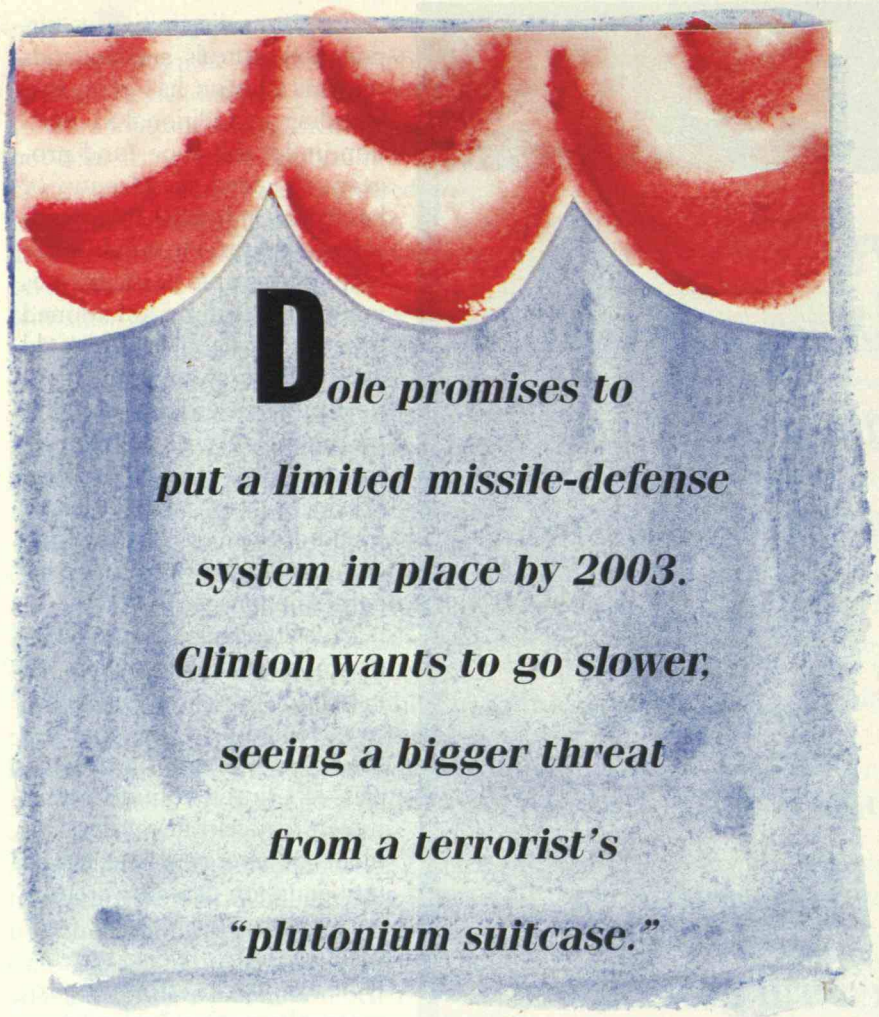
To protect its right flank, a Dole administration might attempt to co-opt the policies of Pat Buchanan, a likely candidate in 2000. Buchanan wants to abolish the Environmental Protection Agency and transfer its responsibilities to existing state and local authorities. While such a move might be difficult to push through even a Republican Congress, Dole would probably be able to impose a five-year moratorium on all environmental legislation—the position advocated consistently by the Dole/Gingrich-led 104th Congress. Dole would, as he and his party colleagues said many times during the GOP primaries, trust market forces and "put people before birds."

A second-term President Clinton, by contrast, would push for a greater role for such Washington-directed programs as recycling initiatives, air-pollution controls, and wetlands reform. Clinton has proposed spending an additional $1.3 billion under the Superfund program to speed the cleanup of hazardous industrial and chemical waste sites. He would offer loans and grants to companies willing to clean up abandoned urban industrial sites and would ask the federal government to post more environmental data on the Internet. A Democratic triumph also would put Vice President and self-professed friend-of-the-earth Al Gore in a commanding position to be his party's nominee in 2000.

Dole does have some environmental pluses in his column. He has endorsed "clean car" initiatives, including the Partnership for a New Generation of Vehicles—a Clinton administration project to accelerate the development of energy-efficient and low-emission cars powered by batteries, fuel cells, or gasoline/electric hybrid systems. Dole also backs efforts to promote alternative fuel sources such as ethanol derived from corn—a popular position for a farm-state senator to take, despite critics who say that ethanol requires more energy to produce than it yields. Dole also promises development of environmentally friendly energy sources, such as natural gas, cleaner coal combustion, and hydroelectric, wind, solar, and geothermal power. The Republican standard-bearer has not, however, squared these goals with his promise of lower taxes and a balanced budget—not to mention his proposed abolition of the Department of Energy. Any fair reading of the Republican platform shows that the mantra of smaller government would take precedence over whatever ecologically sound promises are made.

No Rest for the Weaponry

Although defense spending dropped in the years after the Soviet Union dissolved, Bill Clinton nevertheless presides over a military only slightly smaller than that headed by George Bush during the final days of the Cold War. A sec-



ond Clinton term would promote the development of advanced technologies as a way to increase military effectiveness while holding personnel levels steady.

Many new technologies that might be critical to defense—particularly in telecommunications—will in all likelihood continue to emerge from the commercial sector. The Pentagon is promoting a "dual use" approach to eliminate barriers between commercial and defense industries and to encourage the military to draw on technology and production processes developed for civilian purposes—or, as it is known in defense-speak, OOTW: operations other than war. The administration has proposed a $250 million-per-year dual-use program that would "mesh military needs with commercial-sector innovation and economies of production," according to John Gibbons, assistant to the president for science and technology. Democrats and other boosters of federal research like to cite the example of how government-backed research on data-compression technology in the 1950s led to the development of compact discs in the 1980s; now they see dual-use policy enabling private industry to return such favors.

Dual use is hardly a cause to quicken the nation's pulse, however, and in campaign '96 the attention-getting military policy headlines have been generated by Bob Dole and his embrace of the 1990s version of the Reagan-era Strategic Defense Initiative (SDI). The United States, Dole maintains, has the technical know-how to build a missile defense system, but "lacks the presidential leadership to get it done. We can't destroy a single missile." Thus while Dole and Gingrich made budget cuts in the name of austerity and smaller government earlier this year, congressional Republicans simultaneously added almost $12 billion to the president's request for the 1996 defense budget—including a large increase for ballistic-missile defense in the Defend America Act, one element of Gingrich's Contract with America.

Dole promises that his administration would put in place a working antiballistic missile (ABM) system by 2003. The estimated costs would be "minimal"—$2 billion for the Air Force version and $5 billion for the Army system, according to figures supplied by Rep. Curt Weldon (R.-Pa.), chair of the House Committee on National Security's Subcommittee on Military Research and Development. The Navy also wants to develop a prototype of a missile defense system that would be launched from existing AEGIS-class ships.

Dole's commitment to antimissile technology is firm; the technology itself is more shaky. SDI was extensively criticized for relying on technology that would be mind-numbingly complex and highly vulnerable. Critics in Congress and academia dismissed the notion as a Hollywood-type fantasy. In fact, the idea of a multilayered, space-based system with the daunting, seemingly impossible, assignment of stopping as many as 1,000 incoming Soviet ICBMs, never got off the ground. After tens of billions of dollars were spent on research for a variety of exotic weapons, SDI was scaled back in the early 1990s to focus on ground-based interceptors and sensor satellites to monitor nuclear launch and flight.

Republicans argue that the Defend America Act is not a Star Wars sequel. According to the Dole campaign, the system will pursue the more modest aim of stopping "one or a few incoming missiles." Dole proposes to work with Japan and South Korea on a joint effort to protect all three countries. Supporters envision a single site with the capabilities to repulse missile threats from China and North Korea, among others. The Dole campaign points to the "deteriorating situation" in Russia and the possibility of

nuclear attack from "rogue nations" such as Iraq, Libya, and Iran—or even from drug cartels and international mobsters. The Dole forces cite reports of China's sale of ring magnets to Pakistan and the attempted shipment of Russian accelerometers to Iraq, evidence that such countries are seeking advanced nuclear-missile technologies. Also stoking Republican fears are reports that Russia's SS-25 long-range missile is being marketed at international arms bazaars.

The Clinton administration opposes the Dole plan, doubting the ABM supporters' cost estimates. This skepticism received a boost in May when the Congressional Budget Office (CBO) estimated that an ABM system such as the one Dole advocates would cost closer to $60 billion—12 times the Army estimate. Relying on intelligence reports that say no realistic long-range missile threats will materialize for 15 years, Clinton proposes to continue research and modest development until 1999, so as not to "lock in any outmoded technology," and still to put a system in place early in the 2000s.

Clinton and his Pentagon advisers say they're worried less about incoming ICBMs than about "plutonium suitcases" smuggled into Washington or New York by terrorists. The defense against that threat, they argue, lies not in antimissile systems but in funding intelligence-collection agencies and supporting good police work. And the new Star Wars Lite has also drawn criticism from those who pushed for the real thing in the 1980s. Reagan-era science adviser George Keyworth doubts that the cut-rate shield as now proposed could defend several cities, and continues to advocate the original 1980s SDI concept of space-based defense.

Politically, ABM presents a mixed blessing for both Dole and Clinton. Dole believes the missile-defense issue helps him resurrect the image of the Democrats as soft on defense. But the Republicans don't want to appear to be budget-busters; in the weeks following the CBO report, Dole stopped making references to missile-defense systems. For their part, Clinton and his supporters want to appear tough, but they also believe they can press some emotional buttons by arguing that Defend America is junk science that has more to do with ideology and presidential politics than with national security.

The Clinton campaign also maintains that the 1972 ABM Treaty signed by the United States and the former Soviet Union prohibits development and deployment of missile-defense systems. The Russians, the White House warns, have said that if the United States pursues Defend America, the program could jeopardize implementation of START I and halt Russian ratification of START II, the treaties that cut the number of nuclear warheads and delivery vehicles to approximately one-third of 1990 levels.

Dole, and Republicans generally, question the worth of such agreements. In balancing arms treaties against arms buildup, Dole tilts toward the latter. Dole promises significant increases in military expenditures. His proposals reach beyond those put on the table by Clinton. The candidates also differ on their attitudes toward the Chemical Weapons Convention, which would ban the development, production, and use of chemical weapons. A second Clinton administration would push for Senate approval of this treaty, which was introduced by the Reagan administration and signed by President Bush. Dole, while deploring the horror of such weapons, opposes the treaty, saying it permits overly intrusive inspections and yet would still fail to prevent a determined outlaw nation from pushing ahead. It now appears that the treaty will be ratified only if the Democrats re-take the Senate and thus obtain the necessary two-thirds majority.

Despite Clinton's at least preliminary dismissal of missile defense, both candidates have shown an eagerness to spend freely on large weapons systems—especially when such programs funnel money into hotly contested states. President Clinton, for example, went to California earlier this year to announce new orders for the B-2 stealth bomber production line, which is concentrated in that state. The administration has pledged to deploy a fleet of 21 B-2s, even though the Air Force has said it doesn't want or need any more of these $500 million, bat-winged aircraft. Clinton appointees in the Pentagon would rather devote defense dollars to pay for the Advanced Tactical Fighter (ATF). Dole takes a having-it-all posture; he wants to increase B-2 production beyond the Clinton program and produce the ATF.

Similarly, in 1992, Clinton promised to continue production of Seawolf-class attack submarines (built in Groton, Conn.). This year, when the Pentagon asked for $750 million in 1997 to build a new class of high-tech attack submarines, some critics questioned the value of such systems in the post-Cold War world. The Dole-Gingrich Congress, however, voted to double the Clinton request.

Telecommunications: A Question of Access

Earlier this year, President Clinton signed the most significant revision of communications law in six decades. To dramatize his point that the Telecommunications Reform Act opens the high frontier of cyberspace to colonization by the great mass of Middle Americans, the president used an electronic pad and pen to transmit the signing to the Internet. (The paradigm of pen-and-ink seems impossible to dislodge in Washington, as Clinton passed up the chance to really get into the flow of the Net by affixing a cryptographically secure digital signature.)

The Clinton administration had been promoting telecom reform for the past three years. The elimination of onerous regulatory barriers, the White House contends, will stimulate investment, open up cable and telephone services to new competition, speed the development of computer connections among businesses, classrooms, libraries, hospitals, and clinics, and ultimately lead to universal access to the Information Superhighway.

Although most of the bill's deregulatory measures received bipartisan support, three elements of the legislation have been lightning rods for debate: spectrum, the V-chip, and indecency on the Internet.

SPECTRUM: The Telecom Act designates a segment of the broadcasting spectrum for the distribution of high-definition digital television. Then-Senator Dole wanted this spectrum auctioned off in competitive bidding; he pointed to estimates by the Federal Communications Commission that such a sell-off could raise as much as $40 billion for the U.S. treasury. Instead, the spectrum will be allotted to applicants competitively, but free—a "corporate give-away," in candidate Dole's words.

The White House implicitly acknowledges that the "no charge" provision was the price the administration had to pay to get support from the powerful telecom companies and the entertainment-media conglomerates (and their friends and supporters in the House and Senate). Dole, for his part, has no more troops to command in the auction battle. After he left the Senate, his successor as majority leader, Trent Lott, told the FCC that the House and Senate Republicans were "no longer interested" in auctioning off the spectrum channels set aside for digital broadcasting. While GOP leaders gave no reason for the shift, Congress watchers credited the lobbying efforts of the National Association of Broadcasters—the trade group that represents TV station owners. New opposition to "spectrum giveaways" seem unlikely, unless Dole wins.

V-CHIPS: A more immediate campaign debate revolves around the new law's requirement that manufacturers install parental control devices in all new television sets—the so-called V-chip. As the White House envisions the technology, the television networks and the independent production studios would agree on a scale for rating the amount of violence and sex in any given show. Parents would then program their sets accordingly in order to block out the materials they deem unsuitable for their children.

Again, the technology is straightforward, the politics more convoluted. Dole and the Republican leadership held up the telecom bill briefly because of opposition to the "government intrusion" that the V-chip embodies. The Republicans hold that monitoring TV viewing is a parental responsibility that should not be surrendered to a federal Big Brother.

But since Republicans have for years taken up the cause of "traditional family values," and since Dole himself had scolded the entertainment industry for serving up so much steamy sex and gratuitous violence, the GOP had a tough time sustaining its opposition to the V-chip. The idea of a neat, hand-held electronic tool that enables parents to control what their children watch has considerable popular appeal. Moreover, Clinton moved quickly to steal the "values" ball from Dole. The White House invited media and entertainment industry leaders to a well-publicized summit meeting in Washington "to work with the president on improving what our children see on TV," boxing in candidate Dole and the Republicans. What's more, Hollywood and the networks supported the president's plan—in part to convey their thanks for the spectrum-allocation bonanza. When the Dole-led Senate voted out the telecommunications bill, the V-chip plan stayed.

NET DECENCY: Both Clinton and Dole supported the Telecom Act's controversial ban on online "indecency." But while the courts have long upheld the authority of government to keep objectionable content away from minors, such material cannot be withheld from everyone. The First Amendment, as interpreted by a succession of Supreme Court majorities, doesn't permit it. Nor does the technology, absent blocking devices: on the Internet, what is accessible to adults is accessible to teenagers with a few hours of online savvy.

Clinton and Dole both have said little about the indecency provision, content to leave final responsibility to the courts. Even after a federal district court in Philadelphia found the restriction a clear violation of the First Amendment, both candidates kept a low profile. Within days of the ruling, Clinton issued a statement saying that he remained "convinced" that the Constitution allows the federal government to "prevent children from being exposed to objectionable material transmitted through computer networks." The Clinton Justice Department, acting in part on political calculation and in part on legal autopilot, said it would appeal the Philadelphia decision to the Supreme Court.

Dole has made no such commitment, although the members of the Christian Coalition, a sizable voting bloc in several Republican primaries, continued their support of the indecency restrictions. Given the coalition's influence, a Dole White House might decide to press on if the Supreme Court, as expected, strikes down the law. Dole has already aligned himself with the idea of taming the Internet; he cosponsored legislation last year that would have gone even further in restricting Internet access than does the measure that made it into the Telecom Act instead.

Some hope that advances in the technology of software filtering can help solve the problem of too-easy access to offensive material and that no legal remedy is required. But as both parents and onliners know, the blocking software doesn't quite live up to its promise. The popular Surfwatch program, which limits children's access to Internet sites deemed unsuitable, this year listed the White House home page, www.whitehouse.gov, as a possible porn site because it featured photos of "the First and Second Couples": *couples* was a Surfwatch trigger word. Until software becomes more discerning, it will remain impractical—talked about but not used.

Another Net issue, one that divides the candidates, is encryption—the technology for shrouding communications with virtually impossible-to-break coding schemes to ensure privacy. The Clinton administration calls cybersecurity an "urgent" necessity and has given the FBI juris-



Politics Online

FOR five decades now, American presidential campaigns have been moving indoors, to television news shows and prime-time debates. The voters have become "the audience," to the dismay of critics who deplore couch-potato politics. In this and future election years, though, online technologies provide a chance for the until-now passive watcher to become an active—and well informed—participant.

Computer-equipped voters can use the Internet to read issue papers and press releases, listen to speeches, and watch political video spots. At the official Dole-Kemp '96 Online Campaign site (www.dole96.com), voters can also play interactive games and send virtual Dole postcards to friends. The White House Homepage (www.whitehouse.gov) lets users search by keyword for information on a variety of policies, including those pertaining to science and technology. Visitors to the Clinton-Gore '96 site (www.cg96.org) can enjoy a slide show from recent campaign stops and meet the "volunteer of the week."

The political parties, major and minor, maintain websites with links to other useful sources of information. All invite instant feedback. They can be reached at: The Republican National Committee (www.rnc.org), Democratic National Committee (www.democrats.org), Ross Perot's Reform Party (www.reformparty.org), and the Green Party, with Ralph Nader as its standard-bearer (www.greens.org).

Many nonpartisan organizations maintain Web sites with information about technology issues. Here are some of the best places to find current news and facts about science policy and the 1996 campaign:

■ THE CENTER FOR DEMOCRACY AND TECHNOLOGY (www.cdt.org): One-stop service for the latest on Internet censorship, cryptography, privacy issues, digital infrastructure, and telephony.

■ VOTER'S TELECOMMUNICATIONS WATCH (www.vtw.org): Features "BillWatch," a weekly news-letter tracking legislative actions affecting free speech and civil liberties as well as copyright; the site also offers a "guide to Internet parenting."

■ VOTESMART WEB (www.vote-smart.org): Premiere educational site; provides voting records, issue research and additional political resources. VoteSmart is resolutely nonpartisan—fair, factual, and full.

■ LEAGUE OF CONSERVATION VOTERS (www.lcv.org): Home of the National Environmental Scorecard, which offers no-nonsense listings of voting records on green issues.

■ ENVIRONMENTAL ORGANIZATION WEB DIRECTORY (www.webdirectory.com): Provides hundreds of informative links to science, technology, and environmental sites—everything from agriculture to wildlife.

Leading media organizations also operate Web sites that provide information and commentary on politics and the campaign that are updated daily or in some cases even hourly. The best ones to browse:

■ ALLPOLITICS (www.allpolitics.com): This site takes full advantage of the resources of its parent media organizations—CNN and *Time* magazine—by offering news and analysis directly from their correspondents. The section called "It's the Issues, Stupid" describes the candidates' stands on controversial policies. Our favorite feature, "E-mail from the Trail," provides a candid look from reporters on the campaign trail. It's like reading a journalist's notes over his or her shoulder.

■ MTV CHOOSE OR LOSE (www.mtv.com/chooseorlose): This straightforward site from the Music Television channel presents basic campaign issues useful for all voters, not just those in the targeted 18-24 demographic. News articles are supplemented by frequent road reports on the MTV Bus, as well as by voter surveys. To entice younger Americans, Choose or Lose emphasizes voter education and registration.

■ MSNBC DECISION '96 (www.msnbc.com/news/dec_front.asp): Two media giants—NBC and Microsoft Network—have joined forces to present serious political information. Sections like "The Contenders," "Spin Patrol," and "Scorecard," though clichéd and sporty, nevertheless tell us what we want to know. A section on "The Issues" covers 21 topics, including information on the Internet and telecommunications as well as pages on environment and education.

■ POLITICSNOW (www.politicsnow.com): At this ambitious, highly interactive site, a product of Times-Mirror, Washington Post Co., and ABC News, onliners can consult issue briefs and timelines, the full text of current legislation, the positions of the presidential candidates, and the latest reports from its sponsors' formidable newsgathering organizations. In the "Inter-Action" section, users can participate in live caucuses, as well as weigh in on the question of the day in the "Voter Booth." At "Check the Record," you match your positions with the votes of your senators and representatives. ■

—Edwin Diamond and Gregg Geller

diction over Internet crime. And the Clinton Justice Department has proposed a system, called Clipper, that would permit the U.S. government to hold the keys to any encrypted communication. Clipper would let citizens communicate with each other semiprivately; if a court ordered a wiretap, the government would be able to decipher the encoded transmission.

Dole has sided with the civil libertarians in his opposition to Clipper, saying the approach makes it too easy for the government to monitor electronic communications of innocent citizens. Dole cosponsored legislation—the Promotion of Commerce Online in the Digital Era (Pro-CODE) Act—that would restrict the government's ability to impose encryption standards on private entities. Dole and the bill's principal author—Sen. Conrad Burns (R-Mont.), chair of the Senate Commerce Committee's Subcommittee on Science, Technology, and Space—fear that in a Clipper Chip state "computer users will not be willing to transmit creative content, business plans, or even send letters" because of the knowledge that a government agency could eavesdrop. The Pro-CODE legislation also would relax export controls on encryption technology. The software industry has long pushed for this change.



Dole opposes a Clinton initiative that gives seed money to companies for startup research on promising technologies.

The status of Pro-CODE is uncertain. While a short session of Congress followed the summer-conventions-Labor Day break, the legislative calendar was too crowded for any substantive debate on such a complex—and, to many legislators, unfamiliar—topic.

Cutting R&D—Especially "D"

Since the 1950s, federal outlays to the leading research universities have traced a steep and steady upward slope. Annual federal spending for academic research and development projects now stands at around $13 billion. With both political parties agreeing on the need to balance the federal budget, the slope will turn downward—no matter who occupies the White House. According to estimates from the National Science Foundation, a second Clinton administration could trim the 1995 figure by at least 10 percent over eight years. The Dole cuts could be sharper still.

Not all R&D spending will feel the same pain. The National Institutes of Health, for example, actually received an increase of 5.7 percent in its 1996 budget; experimental vaccines and new surgeries remain a bipartisan favorite. Although the National Science Foundation saw no increase in its budget, nonmedical fields such as astrophysics and molecular biology at least held their own.

Congressional Republicans, from the candidate on down, do argue that while the government should continue to support basic research as well as R&D for defense, the private sector should begin to pay for much more of the applied research that yields corporate payoffs. Dole thus opposes such Clinton initiatives as the Advanced Technology Program (ATP), which gives seed money to companies for startup research on promising technologies. At one point, Clinton said he would not sign the final budget agreement unless ATP was included. Ultimately, the program survived, although the $221 million allotted for it in 1996 was a 40 percent drop from the previous year. The 1997 request is $344 million.

The Dole-Gingrich majority did manage to kill the Office of Technology Assessment, the congressional think tank for science and technology. Ironically, the GOP platform cites an OTA report as the source for a claim that advances in technology account for at least half of all U.S. economic growth. Clinton did not contest the OTA's demise—another sign of the government-averse mood in national politics.

In one area of R&D—space—both candidates stand strong for continued support. Right after his 1992 election, Clinton spelled out his administration's space goals. America's long-term economic strength depends on technological leadership, he argued, and "NASA and the space sta-

ion program represent important investments" in ensuring that leadership. Dole, too, has declared himself "a long-time supporter" of the space station. Both men also concur that funding development of a new generation of space launch vehicles is necessary to replace the aging shuttle fleet.

Despite these stands, the space program overall will face tough times in the next four years, no matter who is elected. To reach a budget agreement this year, Clinton was forced to cut some $5 billion from the NASA budget to a level just under $14 billion; proposed budgets for 1997 and beyond would trim hundreds of millions more. Congressional Republicans have supported such cuts in NASA funding in the past, typically after well-publicized missteps such as the malformed lens on the Hubble Space Telescope.

Although both Clinton and Dole are on the record as supporters of the space program, Clinton seems to find space exploration more intrinsically exciting. The candidates' responses to the possible discovery of evidence of ancient life on Mars were telling. Clinton immediately and ebulliently identified himself with the NASA report—and with a reinvigorated NASA planetary exploration effort. Dole, in stony contrast, offered little comment about the story, and said nothing in all the excitement following the announcement about the NASA budget.

Political imperatives could well trump budget balancing, though. Best-case planning calls for the first elements of the space station to be sent into orbit in mid-1999. A successful launch would provide a boost to the White House occupant at the start of the presidential campaign of 2000. NASA also talks up KidSat, a hands-on fantasy for school children: suitably equipped classrooms would have access to onboard computers and instruments for the remote sensing of earth. It's hard to imagine either Clinton or Dole, as president, resisting the temptation to capitalize on the feel-good aura that such a venture would emanate.

But space stations are Out There—way off in orbit and still three years hence. Right now, the campaign is being waged Down Here, as close to home as the candidates can make it, with their everyday messages about middle-class tax breaks, budgets, deficits, drugs, values, and "bridges" to a better America in the new century. Science and technology have taken a back seat in this election-season trip. But neither President Clinton nor President Dole would serve the nation well by continuing to ignore these issues, once in office. To paraphrase an often-maligned proverb: It takes technology to raise a bridge into the future.★

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HUBS, STRUTS, AND

To find the perfect merging of form and function. . .

By Sidney Perkowitz

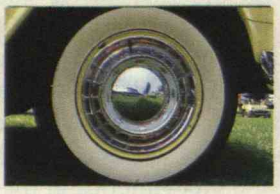

LAND ROVER DISCOVERY






CORVETTE

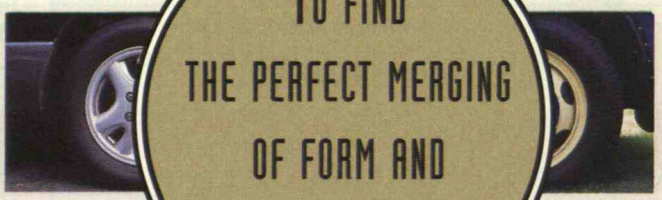

1964 VW BEETLE


1955 CHEVY

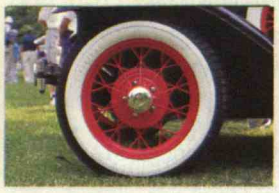

VW VAN


CASE INTERNATIONAL TRACTOR


FORD VAN

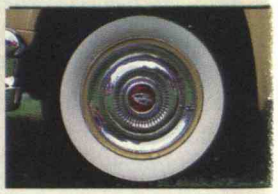

LEXUS BUS


GMC TRUCK 50's


FORD MODEL T

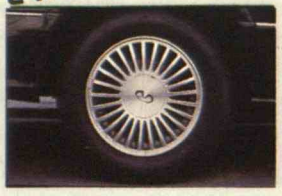

MCI BUS


JOHN DEERE TRACTOR


50's BUICK


STUDEBAKER LARK


BMW MX3


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KUBOTA TRACTOR


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MGTD


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SAAB 9000


JEEP


DODGE TR

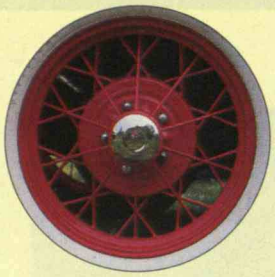
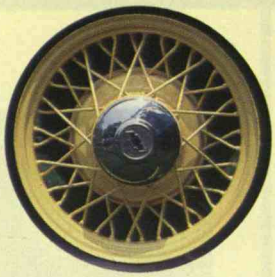
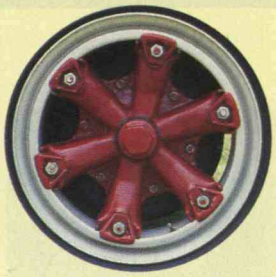

60'S CHEVY


30'S CHEVY


FORD FALCON


CADILLAC


VW JETTA

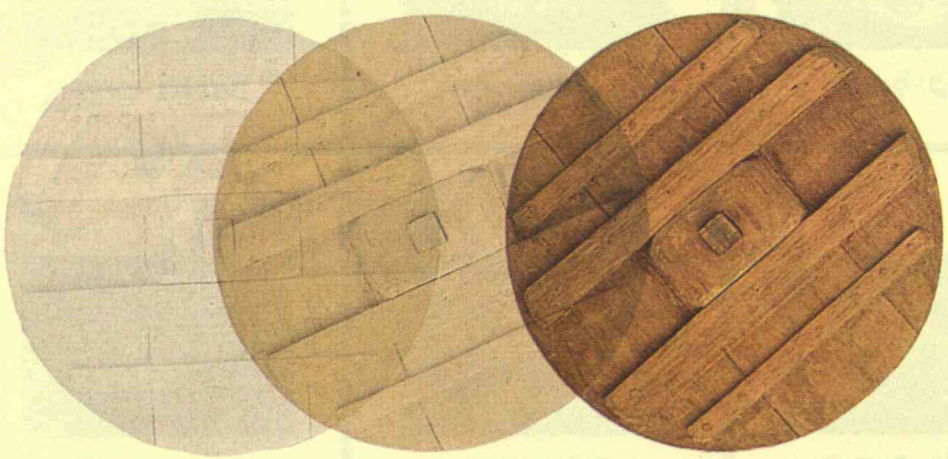
YEARS ago, when I began the hard work of engineering school in New York City, I still found time to haunt the Museum of Modern Art on 53rd Street in Manhattan. While I grappled with calculus and physics, I also encountered the intensity of Vincent van Gogh's *Starry Night*, the strangeness of René Magritte's *Empire of Light*, the delicacy of Claude Monet's *Water Lilies*. Those powerful works spoke to my aesthetic side, but they were not all that MOMA had to offer. On its top floor I encountered another kind of modern art, the art of made objects. Such works spoke to my aesthetic side and my rational side alike, as I learned to appreciate the balanced simplicity of a record turntable, the rightness of form in a laminated wooden airplane propeller, the spatial intelligence contained in a chess set that nested together to exactly fill its storage box.

My career was to turn toward physics, not engineering, but no matter which path I followed, the objects on MOMA's top floor would have lighted the way. They embodied in metal, wood, and plastic an idea that underlies the best in science and technology—the notion of elegance, of concise and beautiful solutions to problems, an idea expressed equally well in powerful mathematical equa-

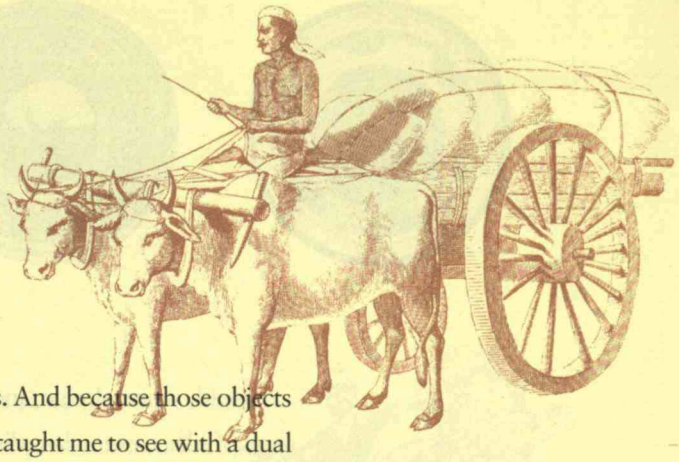


SIDNEY PERKOWITZ, Charles Howard Candler professor of physics at Emory University, writes frequently about science and technology. His book about the scientific and aesthetic meaning of light, Empire of Light, *was recently published by Henry Holt & Company (New York).*

ABOVE: CHARIOT OF ASHURBANIPAL, KING OF ASSYRIA, SEVENTH CENTURY B.C. RIGHT: EARLIEST VEHICLE WHEEL, MESOPOTAMIA, C. 3200 B.C. FAR RIGHT: FIRST BICYCLE, A PEDAL-LESS "RUNNING MACHINE," BUILT BY BARON KARL DE DRAIS DE SAUERBRUN, C. 1817.







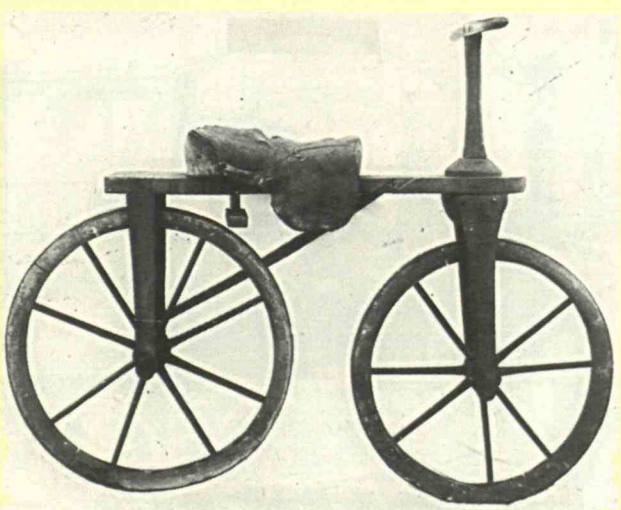
tions, incisive physical theories, and marvelous devices. And because those objects of elegant design united aesthetics with function, they taught me to see with a dual vision that blends satisfaction in knowing how the world works and appreciation of its beauties.

That vision still lets me perceive that our daily world of manufactured objects is full of elegant design. Every city street, for example, houses a fascinating gallery of techno-art—the works of machine aesthetic that grace the wheels of every passing automobile. Within the functional geometry of each wheel, a circular rim joined to a hub fastened to an axle, designers are free to decorate in bewildering variety.

That was not possible for the first wheels, invented in Mesopotamia in the fourth millennium B.C. Those solid disks pieced together from wooden planks were not easily worked into decorative shapes. The spoked form that appeared a millennium or two later in war chariots, and then in vehicles from farm wagons to royal coaches, was a better wheel and offered more design choices; spokes could assume any number of ornate shapes and color schemes. Later still, spokes of iron or wood showed up on early steam engines, and then on automobiles and bicycles. Some evolved into the thin struts of wire wheels, which combined flexible strength and low weight with airy charm. Spokes survive today, but now are only one among many styles of automotive wheels.



Within the functional geometry of each wheel, designers are free to decorate in bewildering variety.



PHOTOS OF ANCIENT CHARIOT AND FIRST BICYCLE: BETTMANN ARCHIVE

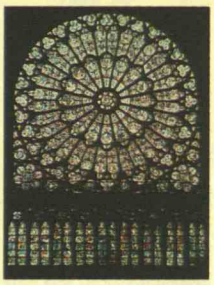




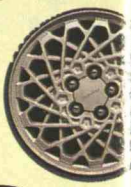




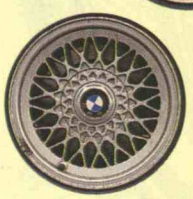
Indeed, wheel design, including decorative hubcaps and covers, expresses all sorts of ideas, even class distinctions. On a small truck or commercial van, each wheel is fastened to a naked hub by visible, perfectly plain nuts—usually five of them—with a simple rib radiating from each nut. Move up from a utilitarian vehicle to a sedan and you see a wheel prettified, but with its mounting nuts still accessible. In some cases, the hub and nuts lurk under a removable cover, as if to shield innocent eyes from the reality of machinery. In others, nuts are exposed but are integrated into a wheel with ribs, struts, slots, or open ports, whose number seems to rise with the price of the sedan.

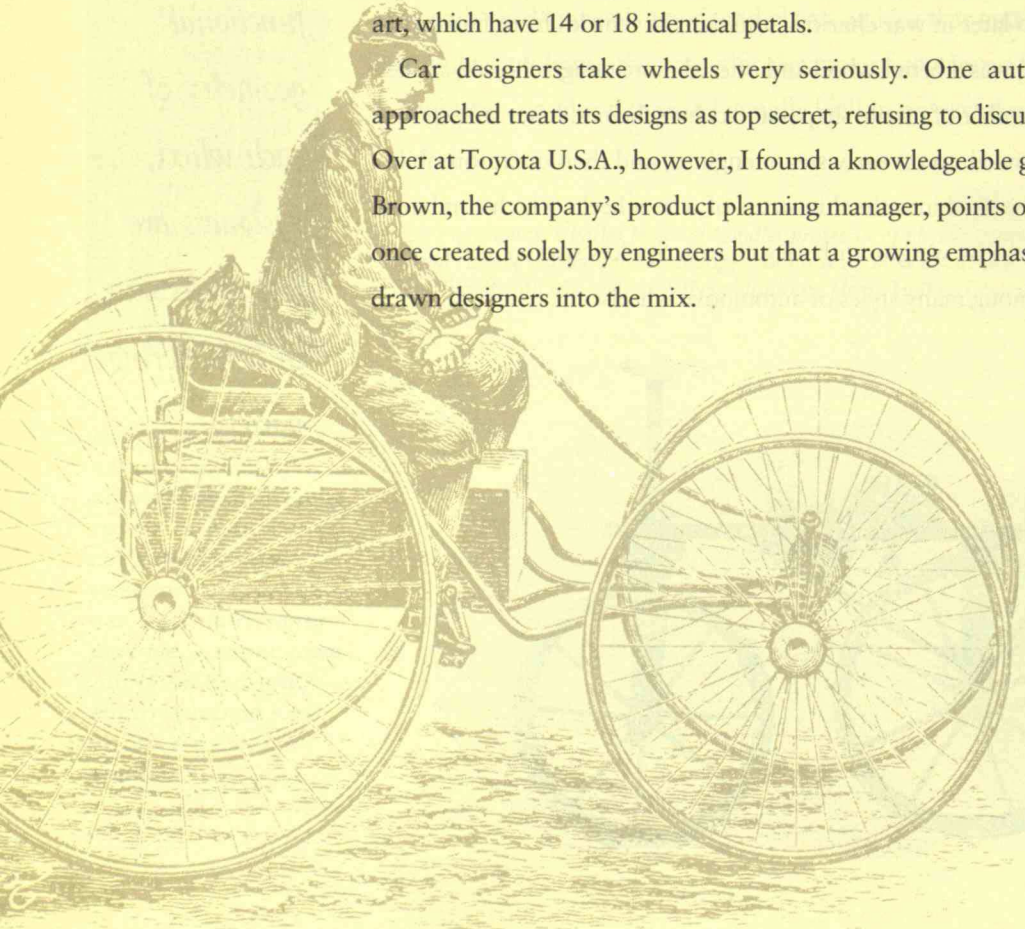


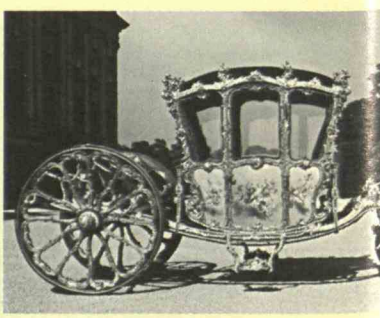
Some wheel designs resonate, intentionally or otherwise, with ancient artistic symmetries: distinctive designs with 14 or 18 ribs seem to echo the circular stained-glass rose window (also called a wheel window) at Notre-Dame Cathedral in Paris—a window with 16 lobes—or the stylized chrysanthemums in Japanese art, which have 14 or 18 identical petals.



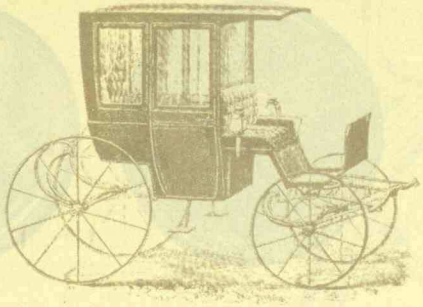
Car designers take wheels very seriously. One automaker I recently approached treats its designs as top secret, refusing to discuss even wheels past. Over at Toyota U.S.A., however, I found a knowledgeable guru of wheels. Don Brown, the company's product planning manager, points out that wheels were once created solely by engineers but that a growing emphasis on aesthetics has drawn designers into the mix.







PHOTOS OF COACH AND ROSE WINDOW: BETTMANN ARCHIVE



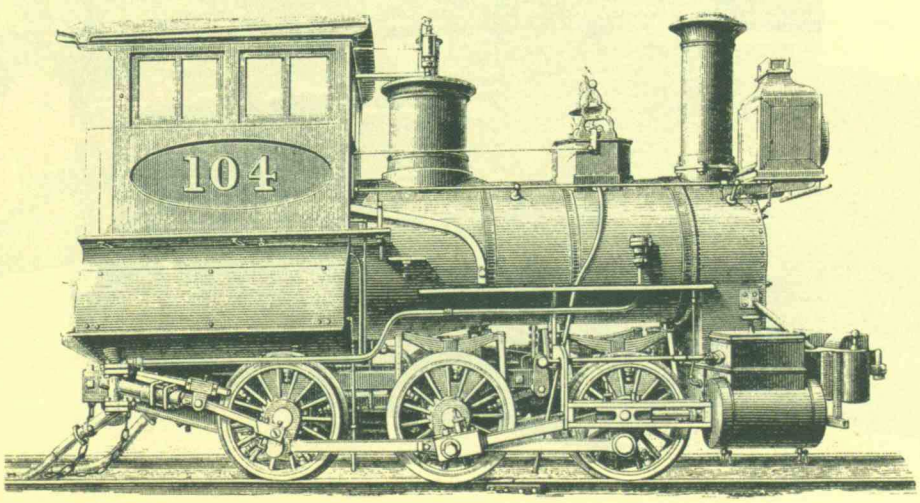
Automakers worry about the look of wheels because customers notice them—if not overtly, then as a subliminal part of a car's total presentation. European car companies like Ferrari have known this all along. Adding the wrong wheels, says Brown, can be as jarring as "wearing the wrong shoes with a tuxedo." Wheels with five plain, chunky ribs match a pickup truck the way workboots go with jeans. The wheels for the first model of the Lexus sedan, in contrast, went through three design cycles before they looked fittingly luxurious.

In designing some parts of a car, automakers can choose whether to highlight style over utility. For instance, every internal-combustion automobile has plumbing to carry exhaust gases from the engine to the open air. Some classic cars of the 1930s sported spectacular chrome-plated exhaust lines that looped from hood to fenders. But the usual design solution has been to decently bury the entire exhaust system under the car; the only concession to aesthetics might be to beautify the visible tip of the exhaust pipe.

Wheels, however, must work well *and* look good. This combination proved elusive in the days when wheels were made exclusively of steel. What was handsome might also be heavy, hampering performance and fuel economy. Now designers can use easily worked aluminum, metal alloys, and plastics to make wheels that are not only strong and lightweight but also attractive. Still, a host of engineering constraints remain. A designer might imagine a look based on, say,



Automakers worry about the look of wheels because customers notice them—if not overtly, then as a subliminal part of a car's total presentation.



CENTER OF SPREAD: STAINED-GLASS WINDOW OF NOTRE-DAME CATHEDRAL. BOTTOM LEFT: FRENCH CARRIAGE BUILT FOR PRINCE JOSEPH WENZEL OF LIECHTENSTEIN, C.1738. BOTTOM RIGHT: NINETEENTH-CENTURY LOCOMOTIVE WITH SPOKED WHEELS.





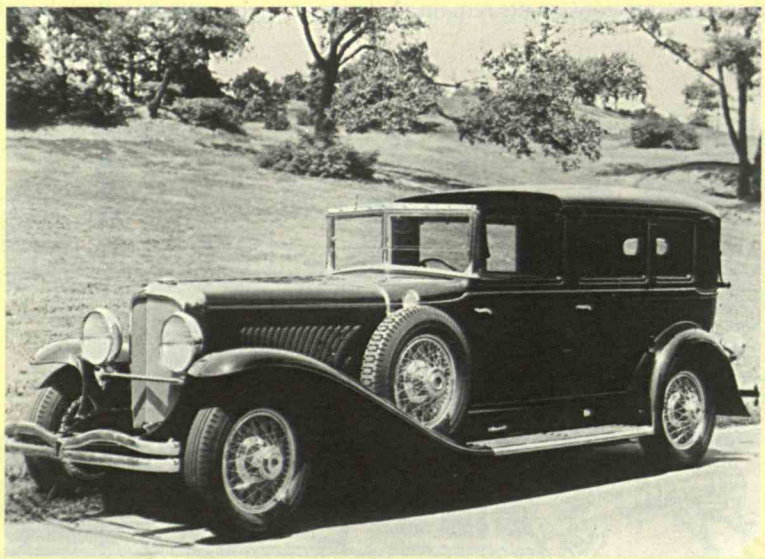
On sports cars, the wheels say "this vehicle can perform" and hint at the underlying machinery.

four mounting nuts rather than five; but engineers tend to prefer five for strength and reliability. Or the designer might want to add three-dimensional elements; but if they protrude too far, they could jam in the tight clearances of a car wash.

Sometimes the mixture of engineering and aesthetics rises above mere coexistence. That happens in sports cars, where the wheels—like the rest of the car—say "this vehicle can perform" and hint at the underlying machinery. The wheels are generally businesslike, with five exposed nuts and five ribs that are sturdy, but shaped to suggest speed—for instance, with a dynamic, tornado-like swirl. The ribs frame large openings to cool the brakes, which remain largely exposed to view. This design might be undesirable in a luxury sedan, but in the high-performance Toyota Supra the physical arrangement and finish of the brake mechanism were carefully chosen to complement the rest of the car.



Even the open ports between the ribs can unite form and function. The wheels on my Nissan 300ZX sports car display subtly asymmetric openings, each defined by a compound arc shaped like a boat's sail taut against the wind. This lovely curve, it turns out, is designed



CENTER OF SPREAD: MODEL OF FIRST MOTORCYCLE, INVENTED BY DAIMLER, 1885. BOTTOM LEFT TO RIGHT: 1930 DUSENBERG; 1912 KISSEL KAR; 1926 BUGATTI TYPE 37A GRAND PRIX RACER.

PHOTO OF DUSENBERG: BETTMANN ARCHIVE



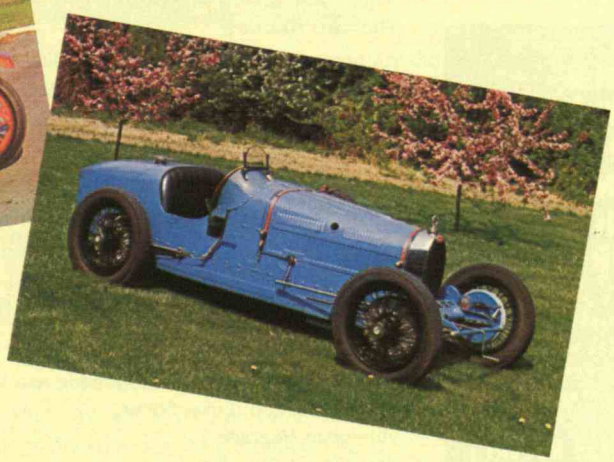
to scoop air from beneath the car, past the brakes to cool them, and out through the wheels.

At rest, the outdoor gallery of wheels is an attractive assortment of still lifes. But seen in dynamic display, with wheels spinning, brakes heating, and air rushing, it represents the elegant blend that defines true techno-art. A designer of wheels might take professional satisfaction in these stylish answers to engineering problems. For me, the blend suggests an answer to another, larger question I am sometimes asked: Is my enjoyment of good design, or of beauty, diminished if I think of the underlying physical reality? Does a handsome manufactured object, or a distant landscape, become less compelling if I consider the details of metallurgical processing, of geological formations?

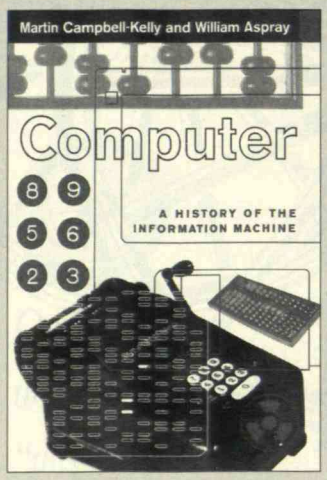
The answer, of course, is that the time I spent studying calculus and van Gogh, physics and the curve of a propeller, only enhanced my vision by focusing it through a scientific lens. Anyone with scientific training has the power to look both at and through the surface of the world, the power to merge visceral reaction and cool analysis into heightened response.■



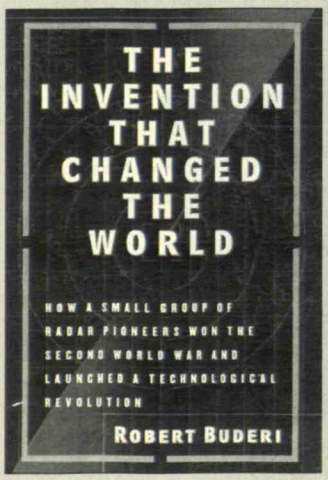




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Medals Are Nice, but....

Dubbed "America's version of the Nobel Prize," the National Medals of Science and Technology fall far short of their potential for spurring public interest in discovery and innovation. The honorees deserve glamour—and money.



ROBERT M. WHITE

DID you hear about the 13 "American champions of research and innovation" that President Clinton honored this spring with the nation's highest honors in science and technology? Probably not—the story barely made the back pages of most newspapers. Therein lies a tale of missed opportunity.

President Clinton called the awards—the National Medal of Science and the National Medal of Technology—"America's version of the Nobel Prize." Alas, they are but a pale version. Recipients of the Nobel Prize become familiar public names as their achievements are lauded in newspaper stories and on television. The laureates become symbols of success for young people, convey the excitement of research, and encourage youngsters to pursue careers in science and engineering. The National Medals of Science and Technology—administered by the National Science Foundation and the Department of Commerce, respectively—could similarly ignite and sustain public interest in the implications of science and engineering. Unfortunately, they don't come close.

One crucial difference is monetary. The Nobel Prize carries with it an honorarium in excess of $1 million. Other international awards also provide a cash bonus: the Japan Prize confers about $500,000 upon its recipient, as do the Japanese Kyoto and Blue Planet Awards. In the United States, similar stipends accompany the National Academy of Engineering's Draper Prize and MIT's Lemelson Prize for innovation and invention. The honoraria for the National Medals of Science and Technology? *Zero*. The scanty publicity follows naturally from the absence of any financial dimension to the awards.

There is precedent for the federal government to go well out of its way to celebrate individuals' excellence, if not with prize money, then with a very big splash. The special treatment given the annual Kennedy Center Awards for achievement in the arts, for example, showcases the nation's top performing artists to a television audience of tens of millions each year. While the works of the Kennedy Center honorees have enriched the lives of Americans, so too have the achievements of the scientists and engineers who receive the National Science and Technology Medals.

One of this year's Medal of Science winners, for example—C. Kumar N. Patel of Bell Laboratories—invented the carbon-dioxide laser, a tool that has become indispensable in surgery and industry. Another medalist, Norman Davidson of Caltech, is credited with chemical and biological discoveries that have led to the earliest understanding of the structure of genomes. The 1996 Medal of Technology recipients included Charles H. Kaman for his pioneering work in helicopter technology and Stephanie Louise Kwolek, considered the principal inventor of Kevlar—the ultra-strong material used in bulletproof vests and fiber-optic cables. Past recipients include Edwin Land, who gave us instant photography, and Robert Noyce and Jack Kilby, who invented the integrated circuit. Their accomplishments merit at least the same attention as those of Frank Sinatra and Katharine Hepburn. That the country's awards processes seem to indicate otherwise suggests that our national sense of values is awry.

Modest steps would go a long way toward remedying this annual oversight. The manner of the awards presentation, for instance, sends a message as to how high an honor the medals reflect. The Nobels are presented by the King of Sweden, the Japan Prize by the Emperor of Japan. Although the president of the United States confers the National Medals of Science and Technology, the ceremonies are brief and little-noted, generally held in the East Room of the White House or in the Rose Garden. To better indicate the importance of science and technology, the president should hand out these prizes more publicly—perhaps at a rousing televised banquet attended by members of the Cabinet and leaders of Congress.

Above all, Congress and the administration should attach a hefty honorarium to each medal—and ignore the contention that a stipend would be crass and somehow contaminate the award. A reasonable level to set for this prize would be between $500,000 and $1 million, with future value indexed to inflation. This year, with 13 recipients of these medals, the total bill to the government would be $6.5–13 million—a pittance when compared with other federal programs and to the contributions these individuals have made to the economic growth of the United States. The cost is absurdly small, the value incalculably great.■

ROBERT M. WHITE, president emeritus of the National Academy of Engineering, is senior fellow at the University Corporation for Atmospheric Research and at the H. John Heinz III Center for Science, Economics, and the Environment.

PHOTO: CLAUDE VAZQUEZ

The Destruction of Childhood

As free trade agreements forge new links to the rest of the world, we are implicitly endorsing brutal economic practices abroad that Western countries banned long ago.



LANGDON WINNER

As my sons devour their burgers and fries at the local fast food restaurant, I examine the toy included with one of the "happy meals" and notice that it was made in faraway Asia. Silently, I wonder: How happy was today's meal for the person who made this piece of brightly colored plastic?

The interwoven, global economy connects us to countless people whose names and faces we will never know. Seldom do we acknowledge these distant others or ponder our role in their well being. Yet every time we buy a product manufactured in a developing country or purchase shares in a global mutual fund, we implicitly endorse conditions of production that affect how people live in other parts of the world.

Headlines of the past year have provided glimpses of the dark underside of the international marketplace. An embarrassed Kathie Lee Gifford tearfully admitted that her line of clothing was produced by sweatshops in Honduras. Michael Jordan smiled and nodded, seemingly unperturbed by criticisms of the brutal Indonesian factories that crank out the pricey sneakers bearing his name. Beyond these media bombshells, however, is deeper, more troubling evidence about the plight of workers, especially children, in the Third World.

A recent survey by the United Nations' International Labor Organization (ILO) revealed that some 78 million children between the ages of 5 and 14 were substantially or fully engaged in labor in 1990—often toiling long hours in physically hazardous and socially abusive conditions. In farms, workshops, mines, and households, children accompany their parents as unpaid laborers, enlisted in the family's struggle to rise from poverty. Given little schooling and scant means for physical and intellectual growth, these young workers are robbed of their childhood and face bleak prospects in their adult lives.

Such exploitation frequently involves the reintroduction of slavery, as children come to be regarded as assets to be bought and sold. The world's economy now includes "tens of millions of child slaves," according to the ILO report. Sometimes adult workers sign contracts that promise the availability of a child; sometimes a child is exchanged for a sum of money that is described by the employer as an "advance on wages."

Extreme advocates of the free market sometimes argue that these practices will vanish as developing societies achieve prosperity. Child labor, in that view, is a temporary problem, one that will be overcome as families work, marshal their resources, and move up the economic ladder. According to one classic argument, children are the best capital families have in their quest for upward mobility, because their "nimble fingers" make them superior to adults for certain kinds of work—rug knotting and electronic assembly, for example.

But such arguments have no validity. What is true for our own children is true for the world's poor as well: the way to improve one's lot in life is through education and the cultivation of higher skills. Varieties of labor that prevent this from happening are bound to perpetuate poverty. Moreover, there is no scientific evidence showing children to be more dexterous in production than their elders are—even if that mattered.

Most countries already have enacted laws that ban or strongly regulate child labor. Over the years, however, governments and whole industries have chosen to look the other way as new generations of youngsters are fed into the meat grinder. Thus the continuing exploitation and abuse of children in the workplace still festers in the shadows of "development."

For now, the most effective initiatives against child labor arise from consumer groups who mobilize public opinion, pressuring governments and business firms to protect the rights of children. A collection of church, labor, and consumer action groups known as the Child Labor Coalition was galvanized by the rebellion and subsequent assassination last year of 12-year-old Iqbal Masih, who had worked in Pakistan's rug factories since the age of 4. The coalition established the Rugmark label—a symbol attached to Asian carpets that the Rugmark Foundation certifies as being made without child labor. Similar efforts are under way to force the garment and sport-equipment industries to demonstrate that their goods, too, are produced under humane conditions. Public pressures of this kind may shame governments into taking steps to combat child labor.

We Americans like to believe that slavery ended with the Emancipation Proclamation and that child-labor abuses stopped with the laws and court decisions of the early twentieth century. Our woes about the global economy focus myopically on matters of national competitiveness and the rise or fall in our own standard of living. How small these concerns seem when confronted with evidence of the suffering of the world's children. We must be vigilant that our wealth and comfort do not rest on a secret inhumanity. ■

LANGDON WINNER teaches science and technology studies at Rensselaer Polytechnic Institute (winner@rpi.edu).

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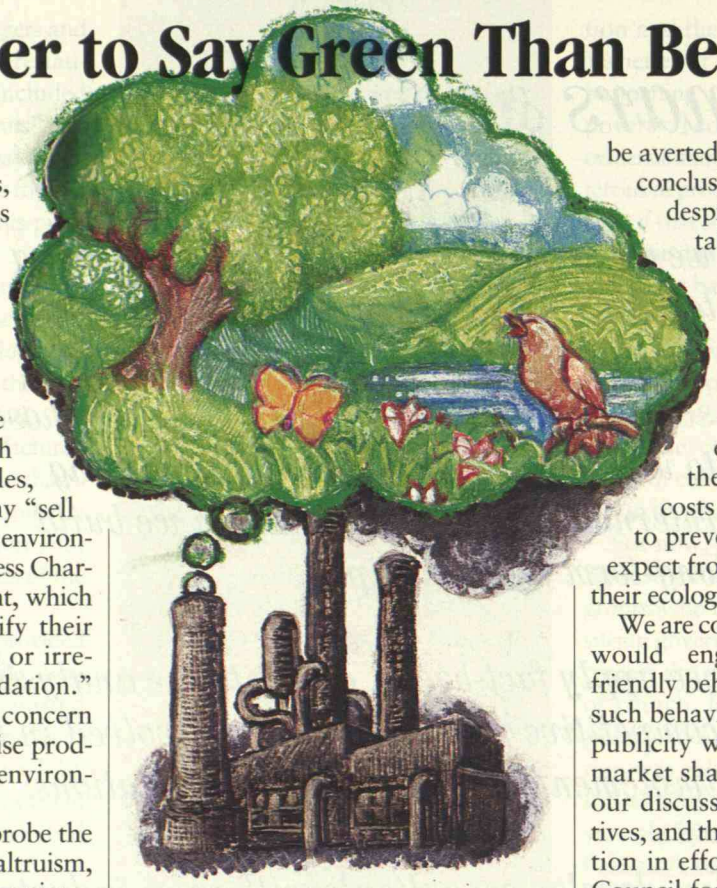
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LESTER B. LAVE AND H. SCOTT MATTHEWS

It's Easier to Say Green Than Be Green



WHEN it comes to environmental awareness, many big companies talk a good game. They issue glossy reports describing Earth Day celebrations and internal recycling activities and expressing strong commitments to preventing pollution. They endorse high-minded proclamations such as the Valdez-CERES Principles, which mandate that a company "sell products that minimize adverse environmental impacts," and the Business Charter for Sustainable Development, which entreats companies "to modify their operations to prevent serious or irreversible environmental degradation." But how does this expressed concern translate into willingness to raise product costs in order to improve environmental quality?

Not very well, it seems. To probe the real-world limits of corporate altruism, we surveyed 54 large U.S. companies—all of which have expressed environmental concerns through actions such as publishing an environmental report. The survey described the following hypothetical situation: Suppose that a material in one of the company's products were found to in some way harm the environment. Further suppose that a nontoxic substitute material were available. The substitute yields exactly the same product quality—but it costs more. How much more, we asked, would the company be willing to pay for this environmentally nontoxic material? Given the nonrandom nature of the survey, we urge caution in generalizing the results. Still, the answers offer insights into corporate priorities for the 25 companies responding.

We posed this question for several scenarios, in which the toxic material accounted for varying percentages of the product cost, and in which the substitute material carried a varying cost premium. When the toxic material constituted 1 percent of product cost, almost all respondents were willing to switch to a safer material that was only 1 percent more expensive. In other words, almost all companies were willing to raise product costs 0.01 percent (for example, $2 on a $20,000 car).

Even the most well-intentioned companies are not willing to significantly raise production costs for the good of the environment.

We were surprised to find how quickly this willingness to pay more to protect the environment fell off. Only two-thirds of the respondents answered that they would be willing to make a substitution that raised product costs 0.1 percent. One-third of firms said they were willing to raise costs 1 percent. Two companies of the 25 said they were willing to raise costs 5 percent. No company was willing to raise costs any further.

Admittedly, the hypothetical situation is vague; it doesn't spell out exactly how much damage to the environment might be averted by switching materials. The conclusion nevertheless seems clear: despite their PR, companies will take measures to reduce pollution only as long as they do not involve much effort or cost.

Remember—the companies surveyed all had publicly professed to be environmentally aware. If they are unwilling to increase costs more than a trivial amount to prevent pollution, what can we expect from firms that *don't* trumpet their ecological concern?

We are confident that more businesses would engage in environmentally friendly behavior if they perceived that such behavior would lead to favorable publicity with the potential of higher market share. Public opinion surveys, our discussions with company executives, and the massive business participation in efforts such as the President's Council for Sustainable Development indicate society's desire for pollution prevention.

In Northern Europe, in particular, consumers gravitate to products that they perceive as causing less pollution. Opel, for example, offered automobiles with U.S. tailpipe emissions-control at a price premium at a time when Germany did not require stringent controls. Opel's market share increased, apparently because German consumers desired a greener car despite the higher price. Managers on this side of the Atlantic believe that few U.S. consumers would respond similarly. In highly competitive industries, where profit margins are low and small differences in price are sufficient to take over the market, it would be suicidal for a firm to raise product costs unless consumers perceived the green product to be superior.

Companies respond to what they perceive consumers want. Some of our respondents, however, expressed frustration that they were unable to tell potential customers about the improvements they had made in their products. The Federal Trade Commission, Envi-

ILLUSTRATION: HENRIETTE SCHERFT

ronmental Protection Agency, and some state regulators have concocted sufficiently narrow definitions of such environmentally related terms as "recycle" and "recyclable" that companies shy away from advertising the positive steps they have taken. IBM, for example, made a computer that was highly energy-efficient and designed to be easily recycled, but the company lawyers thought that advertising these advantages would violate existing rules.

What Makes a Firm Green ?

In many cases, the measures that prevent pollution also save companies money. Pollution is, after all, waste, which signifies inefficient use of resources. Wall Street should reward firms for steps that increase profit, but a firm should have to go beyond steps that raise its profit to earn environmental recognition. We propose five attributes that reflect a company's commitment to invest in pollution prevention and green products.

- *Green consumers.* A green firm invests in understanding the green demands of its customers and the market niches for green products.
- *Technology investment.* A green firm invests in technology to prevent and clean up the pollution that its facilities generate.
- *Materials choice.* A green firm is willing to increase product costs a small amount —perhaps 5 percent—to prevent toxic discharges.
- *Redesign.* A green firm is willing to invest a portion of its product revenues—again, 5 percent seems reasonable—toward a redesign that lowers pollution.
- *Sustainability.* A green firm attempts to lower its use of resources to leave more for future generations.

In an increasingly competitive marketplace, firms must be able to benefit from their green actions. At a minimum, businesses must be able to tell their customers, salespeople, regulators, and other groups about their green actions. Unfortunately, some firms will claim they are green without taking the actions. Thus some mechanism must be put in place to certify the claims. One possibility is to create an organization to establish criteria and then to certify that products meet these criteria. The quickest way to begin these certifications would be for a government agency to consult with the affected companies, then promulgate agreed-upon criteria, and delegate product testing to a nongovernmental organization.

One good model is the Energy Star ratings, created by EPA, for products' energy efficiency. A similar program could regulate claims that a product is recyclable or is made from recycled material, that it is free of toxic materials, and that the manufacturing process produced little or no hazardous waste.

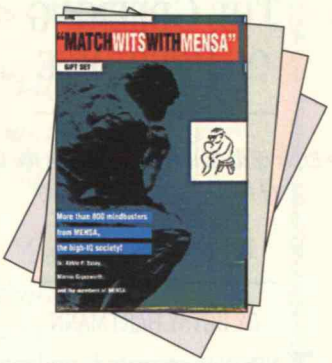
Our proposed attributes are realistic. Some companies define themselves as being on the leading edge of technology, and so commit themselves to be on top of new technology and to performing R&D to develop a stream of state of the art products. Others define themselves as a source of the highest-quality products, where quality is in the eyes of the consumer. Companies of both types make investments that have uncertain payoffs, but generally are successful.

By analogy, we define a green company as one that is committed to informing its engineers about green technologies and tools; to R&D aimed at lowering the discharges of toxic substances; to experimenting with the greenness of its products to elicit consumer response; to lowering the use of nonrenewable resources; and to using renewable resources at sustainable levels. We challenge companies to back up their expressions of environmental concern by making these commitments. ■

LESTER B. LAVE is professor of economics at Carnegie Mellon University and director of the Green Design Initiative, which works with businesses and government to help assure the development of products that are both high-quality and environmentally sound. H. SCOTT MATTHEWS is a doctoral student in Carnegie Mellon's Graduate School of Industrial Administration.

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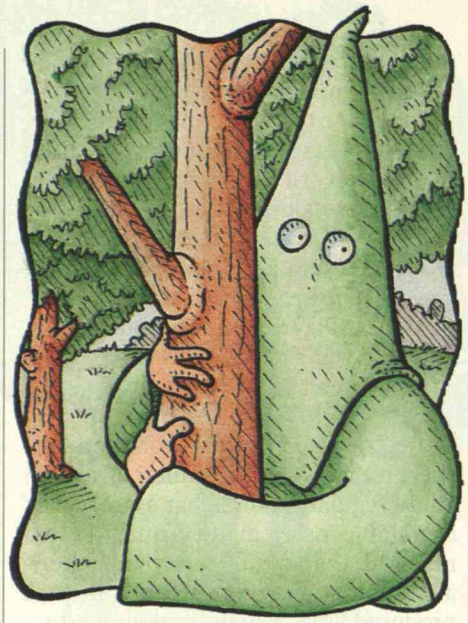
Reviews

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THE GREENING OF PREJUDICE

The Ends of the Earth: A Journey at the Dawn of the Twenty-First Century
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Random House, $27.50

BY BETSY HARTMANN



NATIONAL security is undergoing a redefinition with economic globalization, the growing importance of international institutions, and the end of the Cold War. On the positive side, this allows for a more effective approach to environmental, human rights, and equity issues. On the negative side, viewing these issues through a national security lens can distort them.

The environment is a case in point. Few would dispute that solving serious environmental problems such as ozone depletion, global warming, and pollution of the seas requires international cooperation. But too often the connection between security and the environment is made in such a way as to blame the Third World poor for both political violence and environmental degradation.

Media pundit and *Atlantic* contributing editor Robert Kaplan is one of the more worrisome offenders here, as is clear from his latest book *The Ends of the Earth: A Journey at the Dawn of the Twenty-First Century*. An account of his travels through West Africa, Iran, and Central and South Asia, the book shows that although the author carried only a backpack, his ideological baggage was much heavier. "My goal," he writes, "was to see humanity in each locale as literally an outgrowth of the terrain and climate in which it was fated to live." This was made easier by the fact that he rarely took the time to speak in any depth with ordinary people or read any serious anthropology.

Kaplan may wish to define himself as a liberal environmentalist, yet a close reading of his book reveals a deep conservatism. Just as Charles Murray's and Richard Herrnstein's *The Bell Curve* set out to prove that blacks are intellectually inferior because of their genes, Kaplan maintains that African cultures are inferior to Western and Islamic ones because of the environmental factors influencing them. But he tends to be far off the mark.

For example, he claims that Africa has been relatively isolated from the rest of the world because of its inhospitable coastline and the Sahara desert. In reality, the precolonial era saw extensive contact with merchants from Europe, Arabia, Persia, and Asia, and major trade routes crisscrossed the continent, stretching from the north to the southern Sahara, and following the Nile as well as other rivers. New crops and agricultural techniques from Asia may have spurred large numbers of Africans to settle the central and southern parts of the continent.

Kaplan also argues that Africa's hot climate and natural abundance sap self-discipline. He evidently failed to visit an African village where he might have seen women working hard from dawn to dusk to grow enough food to feed their families. He presents as fact that Africa is the source of AIDS, though this has never been proven. Moreover, he generalizes from West Africa to all of Africa, in effect lumping together people as different as the herders of the Sahel, the farmers of the Kenyan highlands, and the miners of southern Africa. That Africa is a huge and varied continent, with thousands of different cultures and ecosystems, escapes him.

Even within West Africa, Kaplan's analysis leaves much to be desired. Consider his foreboding descriptions of the Liberian rainforest, which are reminiscent of a Tarzan movie. In a land where trees and creepers block the view, "men tend to depend less on reason and more on suspicion," he writes. This "green prison with iron rain clouds" is thus responsible for the animism and spirit worship that have weakened the civilizing influences of Islam and Christianity, and Liberia, a "forest culture," is naturally more prone to violence.

When Kaplan's focus shifts from environment and culture to actual human beings, his conservatism becomes still more apparent. He is enamored of the British colonial writer Richard Burton, who, he notes approvingly, perceived that slaves preferred the "paradise" of the American South and the "lands of happiness" in the West Indies to their native home. Kaplan stereotypes peasants in a wide range of cultures as ignorant, unsophisticated people who destroy the environment through slash-and-burn agriculture, turn cities into "grotesque villages," and readily embrace fundamentalist violence.

But if the humanity of peasants is obscure to Kaplan, that of women is even more so. Most African women, it seems, are bare-breasted and pregnant. Persian women have sensuality implanted in their genes. Rural Indian women are "petite mahogany sculptures." And the maids who clean his hotel in Baku are "ancient female automatons."

Blaming Birth Rates

Because Kaplan fails to see women and peasants as real people, it is easy for him to turn them into faceless masses who are overpopulating the earth. And as it happens, population growth is his explanation for almost every social and environmental ill. He blames it for the sorry condition of many Third World cities, citing the huge influx of peasants into

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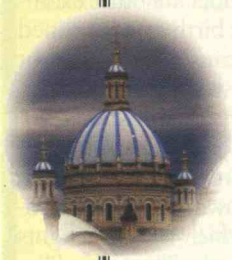
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them. He fails to look at the deeper causes of the migration, which include unequal access to land, lack of investment in basic food crops, and declining terms of trade for agricultural products. Nor does he consider that the ability of urban areas to accommodate new migrants may have less to do with sheer numbers than with the amount of public investment in housing, infrastructure, and jobs, all highly politicized issues.

Kaplan fingers population growth as the cause of deforestation in West Africa as well, whereas a recent United Nations study found no close correspondence between deforestation and population growth in developing countries. Instead, it linked deforestation with large-scale commercial logging, farming, ranching, and mining. Interestingly, even Kaplan's own evidence suggests as much: in Ghana he learns about the ravages of commercial logging, and encounters convoys of logging trucks waiting to export wood to Europe.

Drawing on the more academic work of Canadian political scientist Thomas Homer-Dixon, Kaplan also believes there is a causal relationship between population pressures and violence in many Third World countries, and here he has taken to the airwaves to further promulgate his views. In an interview on the *McNeil-Lehrer News Hour*, he went so far as to suggest that if women in Rwanda had lower fertility, the genocide would not have happened. But the truth is that women's wombs did not breed the violence there. Rather, the blame lies with a complex constellation of forces, including Cold War geopolitics and the arms trade.

A precipitous decline in coffee and tin prices on the international market, leading to a 50 percent reduction in Rwandan export earnings in the late 1980s, heightened economic insecurity. And weapons sales, French military support to the Habyarimana dictatorship, and the failure of the international community to intervene in time all contributed directly to the genocide. As African scholar Jennifer Olsen writes, "The massacres and the war were planned, led, and conducted not by poverty-stricken subsistence farmers but by political and military elites anxious to gain political power."

Indeed, Kaplan would have done well to think about the role of militaries in the environmental problems that so concern him. According to the German Institute for Peace Policy, one-fifth of all global environmental degradation stems from military and related activities. Even after conflict has ended, land mines and the lingering effects of scorched-earth policies and chemical warfare obstruct environmental restoration.

Finally, while Kaplan is right to associate low birth rates with higher standards of living, he is mistaken in assuming that low birth rates cause standards of living to rise. Ample evidence from around the world suggests that it is the other way around—that economic development, improvements in women's status, and widespread access to decent health care, education, and employment lead to lower birth rates. In Thailand, where, according to Kaplan, economic growth and literacy levels rose because population growth declined, more careful examination shows that in fact rapid industrialization and high levels of public expenditure on primary and secondary education helped set the stage for fertility reduction. South Korea, Taiwan, Sri Lanka, Cuba, and Kerala state in India are other examples of places where birth rates declined relatively quickly because of government investment in public welfare.

Recognizing evidence like this, the 1994 U.N. Population Conference in Cairo moved away from a narrow emphasis on population control toward a more broad-based approach in which women's rights figure more prominently. The Cairo Plan of Action called for the education and empowerment of women, and said that greater resources need to be spent on a full range of reproductive health services for women, not just family planning. Kaplan, however, fails to consider any such initiatives. Following his logic, population control, coercive if necessary, is the magic bullet that will pacify Third World trouble spots and save the environment.

A Map of his Mind

It takes Kaplan until the end of his book to acknowledge the gross and growing disparities of wealth in the world. Yet even then his basic outlook is unchanged: for him those disparities have more to do with culture than with colonial legacies, international financial policies, or inequalities in access to resources. Moreover, what little concern he has for the poor is primarily a matter of self-interest. "As AIDS shows, Africa's climate and poverty beget disease that finds its way to the wealthiest suburbs," he notes. He goes on to argue that if we want to protect ourselves from "the demons of crime, population pressure, environmental degradation, disease, and culture conflict," we have to do something.

Kaplan is short on solutions, though. He ignores the emergence of many positive

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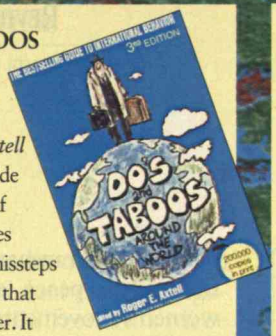
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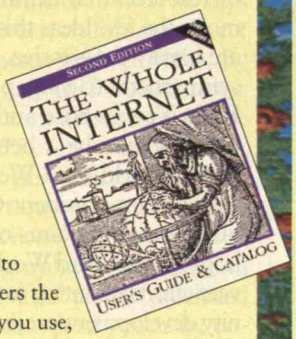
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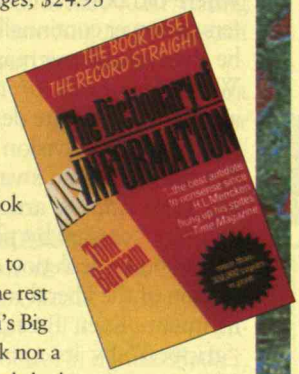
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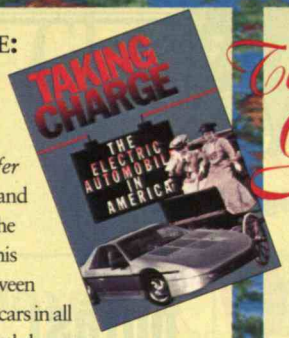
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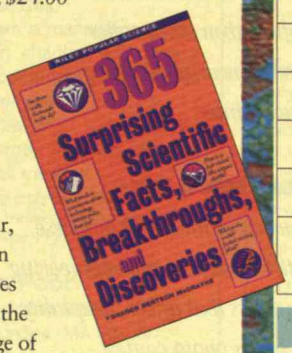
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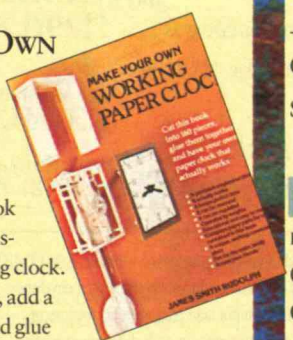
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national and transnational political forces such as the peace, environmental, and women's movements. He acknowledges that Nelson Mandela is a gifted policymaker, but warns that South Africa's high population growth and diminishing natural resources may defeat his efforts. What's more, the few ideas this author does offer are hardly progressive. For instance, he is sympathetic to Singapore's dictator Lee Kuan Yew, whose authoritarian rule he believes may be a better model for the Third World than Western democracy. And like ex-president George Bush with his "thousand points of light," he draws hope for the Third World mainly from private efforts, pointing to one small community development project in India.

Although Kaplan intends to sketch a new map of the world—"an ever-mutating representation of cartographic chaos" where old borders crumble and the centers of power continually shift—in the end he gives us a clearer map of his own mind. Were *The Ends of the Earth* simply another travelogue destined for a dusty shelf, his limited vision might not matter. But his ideas hold sway in Washington. His 1994 *Atlantic* article on the "coming anarchy" caused by population growth and resource depletion captured the imagination of the liberal foreign-policy establishment. Even President Clinton was "gripped" by its apocalyptic message. More recently, Secretary of State Warren Christopher has joined Kaplan in blaming population growth and resource depletion for a variety of political disasters.

A genuine greening of security may well be in order, but foreign policy based on the flagrant scapegoating of women, the poor, and Africans in particular has little to do with it. Kaplan's point of view needs to be seen for what it is; otherwise we risk creating conditions under which environmental problems continue unchecked and we succeed only in deepening prejudice and heightening the fear of people beyond our borders.■

BETSY HARTMANN is director of the Population and Development Program at Hampshire College and the author of Reproductive Rights and Wrongs: The Global Politics of Population Control *(South End Press, 1995).*

In the August/September 1996 Letters to the Editor, Paul Brodeur caps his argument against Jon Palfreman's piece "Apocalypse Not" (*TR April 1996*) by citing the unanimous conclusions of a National Council on Radiation Protection (NCRP) committee, which he says found a link between childhood cancer and electromagnetic fields (EMFs). By stating that these NCRP conclusions "received prominent attention" in the August 18, 1995, issue of *Science*, Brodeur implies that Palfreman overlooked an important and authoritative analysis of EMF's health effects.

The four-paragraph item in question reported that an NCRP panel "produced a draft report" that had yet to be endorsed by NCRP's scientific council. The piece even quoted NCRP president Charles Meinhold as saying the report "has no standing" until the NCRP vetting is complete. As of late August 1996, such appraisal has not yet been finished.

PETER SPENCER
Editor
Consumers' Research
Washington, D.C.

BACKSTOPPING CONGRESS

The kinds of questions Richard E. Sclove indicates are being asked at "Town Meetings on Technology" (*TR July 1996*) are not really technological in nature. Rather, they are social questions related to technical matters. Comparing the lay panel reports with studies by the Office of Technology Assessment (OTA) is misleading, since OTA's focus was specifically to produce the kind of "expert background papers" that could be used by such lay panels.

The idea of convening a lay panel to evaluate the use of technology stems from the notion that the interests of the American people are not being adequately represented by the 535 members of Congress, who were supposed to use the OTA reports. I think most citizens would agree with this notion. In fact, why limit the use of lay panels to technology-related issues?

TODD M. TAMURA
Cambridge, Mass.

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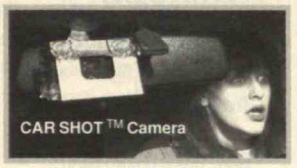

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Phenomena

By David Brittan

A Martian Microbe Talks Back

To: Supreme Commander, Mars Imperial HQ
From: Group Leader, Earth Exploratory Mission
Re: The Search for Life

Has it really been 13,000 years since I last wrote? We've had our hands full (to borrow an earth expression) since landing at the planet's southern pole. As soon as we ventured outside the ship, we encountered what we reckoned to be an advanced civilization of huge six-pointed beings—and when I say huge, I mean at least a millimeter across. We spent thousands of years cataloging them before realizing our error. The hexagons turn out to be made of nothing more than water, as we discovered when we held a cookout in their honor. It's a pity—they seemed so well organized, so polite. Did you know that no two are alike?

After our exhaustive search, which covered nearly 6 square centimeters, I can safely report that the earth is devoid of life as we know it. By that, of course, I mean devoid of wormlike microbes that are smaller than 100 nanometers across, that thrive at cryogenic temperatures, and that wear red bowties on alternate Tuesdays. Folks like you and me. I can, however, report that the earth is swarming with *non*living creatures.



Just two years ago, as we were mopping up after the ill-fated barbecue, I spotted an absurdly large, cumbersome brute bumbling across the frozen surface. It was so big that if you were to stand on top of it you would just make out the curvature of its head on the far horizon. When I first saw its face, I had kind of a déjà vu. I said to myself, "Where have I seen a formation like *this* before?" Then I remembered: that huge cement plant back on Mars, the one the primitive Cydonians built eons ago. It's visible from space, I believe—so who knows, maybe the earth creatures think our cement plant looks like a face. Anyway, I've taken to calling them cementheads, which always cracks up the crew.

If you ask me, the cementheads are just too massive to qualify as life forms. Instead of treading lightly upon the earth—as we certainly do, thanks to quantum electrostatic effects—they struggle and strain against the pull of gravity and set off seismic tremors with each clumsy step. And so hot! The chemical activity in their bodies must be rapid enough to burn out any organic systems in no time—perhaps a few tens of years. Worse yet, the cementheads are almost certainly infected with DNA. How else to account for their dreadful taste in clothing? Loud colors, synthetic fabrics—ghastly. The double helix seems to run the same insidious course on every planet it strikes: genes compete to replicate themselves, species "evolve," and pretty soon you've got crime, pollution, and T.J. Maxx. You might, by some stretch, call it life, but you wouldn't call it living.

Cydonian cement works, Mars

If the cementheads have one redeeming quality, it is their mindless obedience. When the first creature approached our ship, I shouted: "You there! Come over here and pick us up this instant!" (When you're small, it helps to be a bit imperious.) The cementhead took its sweet time, in the shiftless, lackadaisical way that seems to typify these creatures, but finally lifted the ship to its face. It was then that I noticed another redeeming feature: its breath. To our delight, the earth creatures suck deadly oxygen out of the atmosphere and replace it with life-giving CO_2. Each gusty exhalation is like a whiff of home. "Keep breathing," I commanded, "and don't stop until I tell you to!"



Me

Although it's fun to order the cementheads around, the "mindless" part gets on your nerves after a while. The creature who found us kept turning the ship over and over in its paws. You should have seen the pandemonium on the bridge, with the crew slamming up against the main console, and me swaying back and forth in my big captain's chair yelling, "Uh, hello? Hello?" Then the cementhead tossed us into a sack along with the trade mission from Saturn and the Grand Venusian Army. Honestly, you'd think these beings didn't know a sophisticated nano-engineered interplanetary spacecraft from a rock on the ground.

So, as I was saying, we were abducted by aliens. They took us to a laboratory full of bright lights, where creatures in shiny suits stuck probes in us and, I'm pretty sure, attempted to have sex with us. Meanwhile, they totaled the ship, cutting clean through the crew compartment. No sign of Sharon or Doug.

The cementheads seemed no more concerned than if they had been preparing a geologic specimen for study. But don't worry, I was firm with them. I demanded that they replace the ship and pay for our return voyage. They bent to my wishes as usual, and are now building a series of Mars landers for us to choose from. I'm sure we'll end up in some childish contraption cobbled together from titanium and Mylar, but it should get us home. There is even talk of a "Mars sample return mission," in which a lander will scoop up a few kilos of Martian soil and carry it back to earth. Are you thinking what I'm thinking? Our entire civilization just got a free ticket to the Blue Planet!

Of course, it won't be a blue planet for long, I'm happy to say. Our other little project, the martiforming of earth, is proceeding as planned. CO_2 levels are building nicely, atmospheric temperatures are rising, and vegetation is disappearing at a satisfactory rate. Within a few short centuries, the noxious oceans and oppressive air will burn off, leaving behind a frigid desert hospitable only to life as we know it. Then we will never have to wear these ridiculous little stone spacesuits again. ■

PHOTOS: NASA

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January	October 28	December 3
Feb/Mar	December 12	January 19
April	February 1	March 5
May/June	March 18	April 19
July	May 1	June 4
Aug/Sept	June 17	July 19
October	August 1	September 3
Nov/Dec	September 16	October 18

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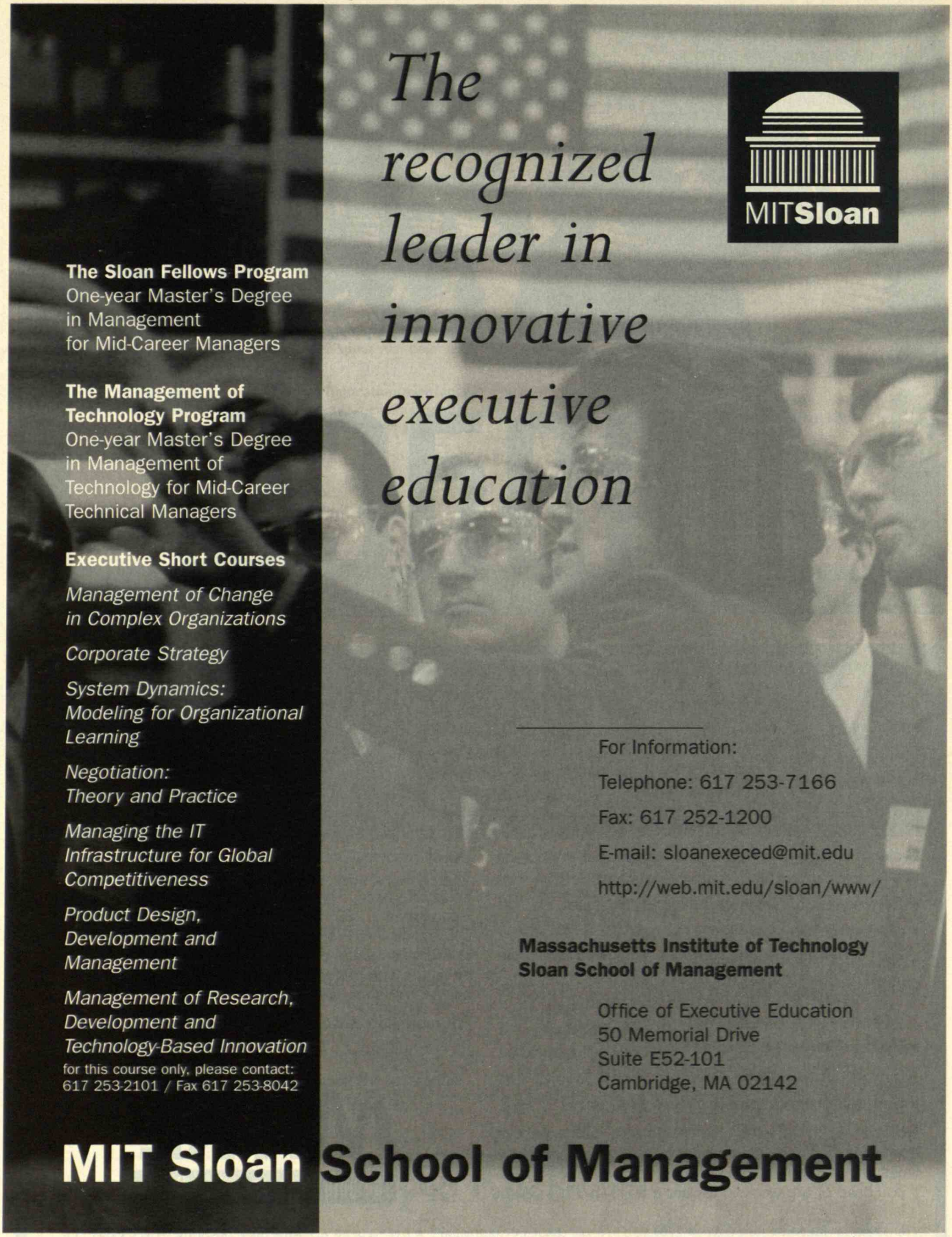
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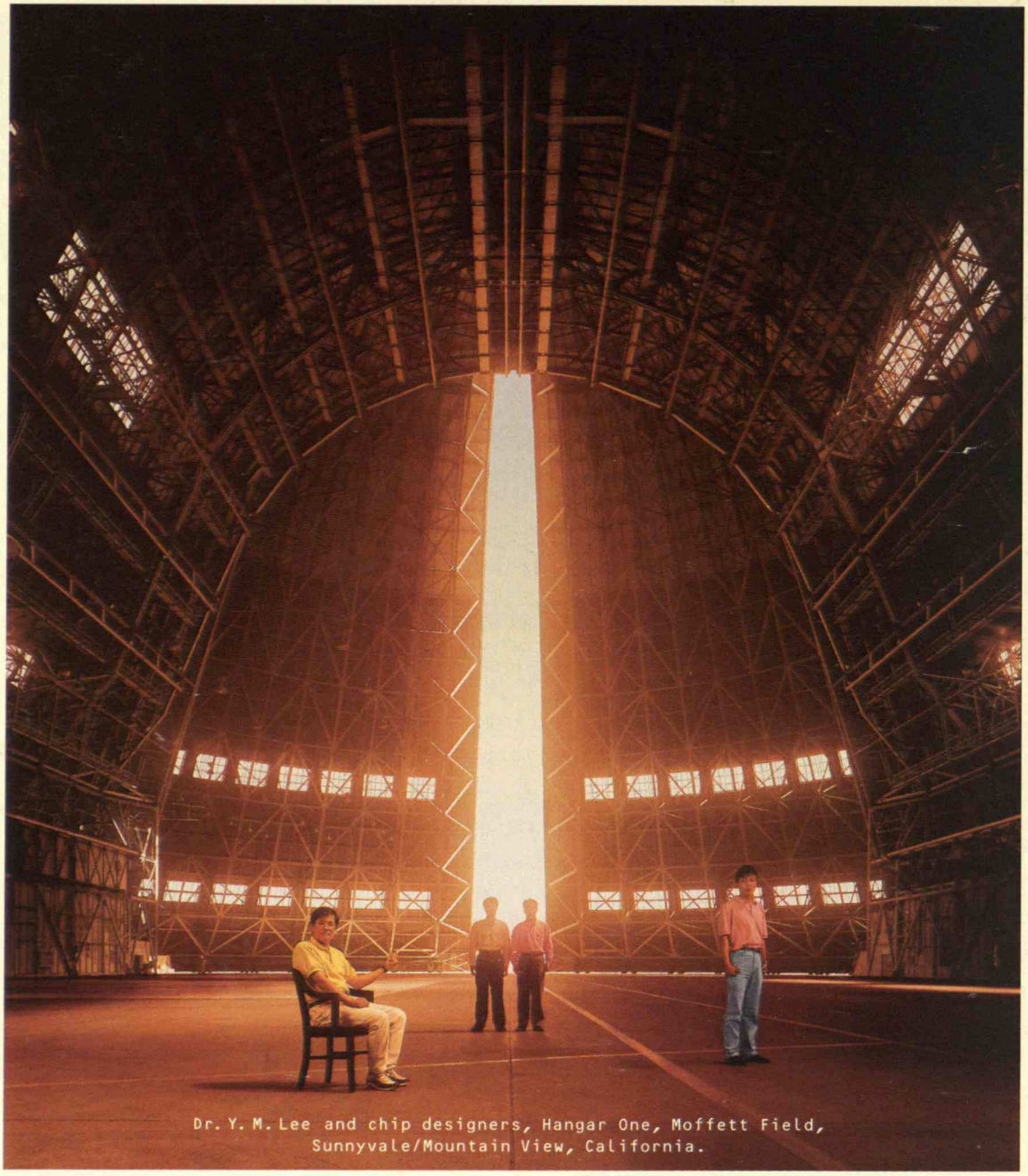
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